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Geotechnical Engineers,

Geologists and

Hydrogeologists

REPORT ON
GEOTECHNICAL STUDIES FOR
PROPOSED IMPROVEMENTS TO
REACH E SEAWALL
ROUGHANS POINT
REVERE, MASSACHUSETTS

by

Haley & Aldrich, Inc. Cambridge, Massachusetts

for

Department of the Army New England Division Corps of Engineers Waltham, Massachusetts

February 1990

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Consulting Geotechnical Engineers, Geologists and Hydrogeologists

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Department of the Army New England Division Corps of Engineers 424 Trapelo Road Waltham, Massachusetts 02254-9149

Mr. Anthony F. Mancini Attention:

Chief, Geotechnical Engineering Branch

Subject:

Geotechnical Studies

Roughans Point

Revere, Massachusetts

Gentlemen:

We are pleased to submit ten copies of our report on geotechnical studies of the proposed improvements at Roughans Point, Revere, Massachusetts. This work was performed in accordance with our Contract No. DACW33-89-D-004 dated 13 July 1989, and our proposal dated 20 October 1989.

We appreciate the opportunity to work with you on this project. Please call us if you have any questions or need additional information. We look forward to assisting you on future projects.

Sincerely yours, HALEY & ALDRICH, INC.

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TWP:ADS:DGG:aw/0723i

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I. INTRODUCTION

1-01. SITE LOCATION

This report presents the results of geotechnical studies for the proposed improvements to the existing seawall at Roughans Point, Revere, Massachusetts. The general location of the site is shown in Figure 1 - Project Locus, and Figure 2 - Exploration Location Plan and Profile. The site presently consists of a seawall approximately 1700 ft. long bordered by the Broad Sound shore to the east, and houses along Broad Sound Avenue to the west. This area is identified as Reach E by the U.S. Army Corps of Engineers (USACE).

1-02. PROJECT DESCRIPTION

The USACE has proposed improvements to the existing seawall, consisting of stone berms, stone revetments, and a concrete cap to reduce overtopping of the existing seawall. An earth berm and sand bags are proposed for backwater protection, and a gravity drain and a sluice gate to control interior drainage. The proposed improvements to the seawall and the revetment as designed by the USACE are shown in Figure 3 - USACE Proposed Seawall/Revetment Improvements. In general, the proposed revetment consists of 11 ft. of stone backfill extending horizontally 25 ft. east of the existing seawall. The revetment then is sloped at approximately 3H:1V to the existing ground surface. A toe berm detail is included to reduce scour.

1-03. SCOPE OF INVESTIGATION

The primary purpose of this study was to investigate subsurface soil conditions at the site, and to investigate the potential effects of the proposed seawall improvements and revetment construction. The general scope of services developed by the USACE and amended by our 20 October 1989 proposal for the geotechnical studies is as follows:

- o Review of previous Government studies furnished by the USACE.
- o Soil explorations consisting of 5 test borings and 5 test pits.
- o Laboratory testing of selected soil samples.



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- o Assessment of the existing wall stability and condition.
- o Assessment of the affects of the proposed construction on the stability of the wall.
- o Assessment of the potential settlement of the wall, the adjacent ground and the two closest structures.
- o Recommendations for potential wall modifications to facilitate the proposed construction.

The scope of services is limited to consideration of the existing seawall, the proposed improvements to the seawall, the construction of the proposed revetment, and the two closest structures.

These studies were conducted in accordance with the original scope of work prepared by the USACE dated 29 September 1989, the Haley & Aldrich, Inc. (H&A) proposal dated 20 October 1989, and the no cost change order dated 14 December 1989.

1-04. QUALITY CONTROL

The geotechnical studies in this report were conducted in accordance with generally accepted engineering procedures. Field exploration and testing, laboratory testing, and engineering analyses were conducted and reviewed by qualified and experienced personnel. H&A field procedures were reviewed by various USACE personnel during periodic field visits.



II. SITE CONDITIONS

2-01. EXISTING CONDITIONS

The seawall consists of cantilevered steel sheet piling, embedded in the underlying soils, faced with concrete where it is exposed above grade. The exposed concrete wall varies in height from approximately 4 ft. on the west side to 15 ft. on the east side of the wall. The top of the concrete cap is approximately El. 17.6*, based on six spot elevations determined as part of this study along the length of the wall. A former pier and a breakwater are located at the north end of Reach E. The wall abuts an MDC seawall adjacent to Winthrop Parkway at the south end of the reach.

The site is bordered to the west by homes and Broad Sound Avenue. The existing grade slopes downward from the wall backfill at approximately El. 13.5 toward Broad Sound Avenue. Broad Sound Avenue slopes from El. 15 to El. 4, from south to north, but is generally below El. 5 for the length of the reach. The east side of the site is bordered by the Broad Sound.

The tides vary from mean high water at El. 4.9 to mean low water at El. -4.6, exposing the previously placed riprap boulders and sandy beach at low tide. The wall has been overtopped during coastal storms and severe flooding of the inland has occurred, as during the 1978 storm of record.

2-02. PREVIOUS CONSTRUCTION

Available records provided by the USACE indicate that the wall was designed and built in 1936. Figure 4 - Approximate Cross Section of Existing Seawall shows the available information regarding the wall cross-section (Ref. 1 and 2)**. Construction in 1936 apparently consisted of driving the steel sheet piling into the underlying silty clay (Ref. 1). A concrete cap and face was subsequently formed and poured around the piling, and the wall was backfilled on both sides. The west side of the wall was backfilled to approximately El. 13.5, while riprap boulders were placed along the east side of the wall (Ref. 2).



^{*} Elevations in this report are in feet relative to the National Geodetic Vertical Datum (NGVD).

^{**} References are listed in Section VIII.

A narrow asphalt walkway was placed on top of the backfill on the west side of the wall.

The seawall was repaired in 1955 and 1972. Records are not available for the work conducted in 1955. Available USACE plans indicate that the concrete face was repaired and the wall was capped again in 1972. Apparently as part of the 1972 repair, a concrete lip was formed at ground level on the east side of the wall, to facilitate construction of the new concrete face. Although plans indicate the top of the lip was to be formed at approximately El. 0, two recently surveyed lip elevations vary from El. 3 to 4. The thickness of the riprap boulders varies also and the lip is exposed at some locations along Reach E. Observations at specific locations are discussed in Section III and Section V.



III. SUBSURFACE EXPLORATIONS

3-01. PREVIOUS BORINGS

Borings were conducted prior to the original construction of the wall (circa 1936), and again in 1987 in conjunction with the USACE Coastal Flood Protection Study. A summary of the previous explorations is shown as Subsurface Profile A-A on Figure 2, and was taken from engineering log profiles prepared by the USACE (Ref. 3).

Sixteen borings were completed for the 1936 design of the seawall. The original driller's logs are not available, but profiles are shown on Reference 1, as well as on Figure 2. These original borings are designated by the prefix MDC-36. The depth of the borings varied from approximately 21 to 44 ft.

Seven borings were conducted within Reach E for the USACE in 1987. These borings are designated on Figure 2 by the prefix FD-87. The borings were conducted by Atlantic Testing Labs, Ltd., and varied in depth from 15 to 56.5 ft.

3-02. TEST BORINGS FOR THIS STUDY

The results of the previous test borings were used to assess the general stratigraphy; however, since the previous data included only a very limited amount of classification type testing, a program of field explorations with field and laboratory testing was proposed by the USACE for this study.

The test borings for this study were conducted during the period 6 December 1989 through 26 January 1990. Five test borings (designated as B89-1 through B89-5) were drilled by Guild Drilling Co., Inc. of East Providence, Rhode Island. The boring locations and required depths were reviewed by the USACE. These explorations were monitored by H&A personnel.

The borings extended from 39 ft. (B89-1) to 61.3 ft. (B89-4) below the existing ground surface. As-drilled boring locations and ground surface elevations are shown on Figure 2 - Exploration Location Plan and Profile. The boring locations were determined in the field by H&A personnel by taping relative to existing site features. Ground surface elevations at the boring locations were surveyed by Bryant Associates of Boston, Massachusetts, relative to the benchmark at the MDC Police Station at Revere Beach. Boring logs prepared by the



drilling contractor and reviewed by H&A are included in Appendix A.

The boring logs indicate descriptions based on visual/manual procedures conducted in the field. The two letter general group symbol following the sample description is the ASTM designation which reflects additional information obtained from the laboratory tests. The field visual description has been edited for the samples tested.

All of the borings were advanced with steel casing using wet rotary techniques to clean out the casing. Casing sizes ranged from PW (5 inch) to BW (2.5 inch). Typically, PW or HW (4 inch) casing was used to advance the borehole through the surficial fill deposits, and HW casing was used below this stratum through the organic soils and the marine clay. B89-2 was completed with BW casing to advance the borehole past an obstruction encountered at approximately 30 ft. depth. The HW casing was driven through the organic and clayey soils in order to conduct field vane shear tests (FVST) and to obtain thin wall tube samples (TWTS) for laboratory soil testing. A total of six FVST's were conducted, and 10 TWTS were obtained, at locations and depths as noted in the driller's logs. Results of the FVST's are summarized on Figure 5 - Engineering Parameters of Organic and Clay Soils. The FVST results shown are corrected for vane size in accordance with ASTM D 2573, and for plasticity, as recommended by Bjerrum (Ref. 7).

In addition to the FVST's and the TWTS, standard split-spoon samples were obtained in all of the borings. The samples were generally obtained at five foot depth intervals or between the FVST's and the TWTS. The Standard Penetration tests (SPT) were performed in accordance with ASTM D1586. Standard Penetration tests were conducted during the split-spoon sampling and the hammer blows to advance the sampler each 6 in. interval were recorded.

3-03. TEST PITS

A total of five test pits were excavated as part of this study. Three test pits were excavated within the tidal zone at locations designated by the USACE to obtain samples for environmental testing. Two test pits were excavated along the seawall, primarily to expose the steel sheet piling to observe its condition.



The test pits were excavated by J. Marchese & Sons of Everett, Massachusetts, between 4 and 6 January 1990, and were logged and monitored by H&A. The test pit locations were determined in the field by H&A personnel by taping relative to existing site features. Ground surface elevations of the test pit locations were surveyed by Bryant Associates, of Boston, Massachusetts, relative to the benchmark at the MDC Police Station at Revere Beach. The test pit locations are shown on Figure 2. Test pit logs including sketches are included in Appendix B.

The three environmental test pits (TP89-1 through TP89-3) were excavated at Reach D and E during low tide. The test pits varied from 7.5 to 11 ft. below existing grade. Jar samples were obtained at 2.5 ft. intervals. Each sample was obtained with a clean stainless steel sampler, and was preserved in a jar provided by the USACE. The jar samples were kept in a cooler and delivered the same day to the USACE laboratory in Waltham, Massachusetts. Bag samples of granular soils were also obtained, and delivered to the USACE. Chain of Custody reports for the samples are included in Appendix D.

The two seawall test pits (TP89-4 and TP89-5) were excavated on 5 and 6 January 1990, to determine the approximate configuration and condition of the below grade steel sheet piling. The test pits were monitored by H&A. TP89-4 was also observed by USACE personnel.

In summary, the seawall test pits revealed that the steel sheeting is in good condition, with only surficial corrosion evident. No severe distortion or deterioration was evident at these two locations. However, different concrete wall conditions were exposed at the two test pits. A concrete block or footing was exposed below the lip of the wall at TP89-4. The concrete lip was encountered at higher elevations than was indicated on the 1972 plan of the proposed repair (Ref. 2) at both test pit locations. The elevation survey indicates the top of the lip varies from El. 3 to 4. Sketches of the conditions observed at test pits TP89-4 and TP89-5 are included in Appendix B. Bag samples of granular soils were obtained and delivered to the USACE laboratory in Waltham, Massachusetts. A block sample of the clayey peat was obtained from TP89-5 for laboratory strength and consolidation testing.



IV. LABORATORY TESTING

4-01. TEST PROGRAM AND PROCEDURES

Laboratory tests were conducted on selected samples to better define the properties of subsurface soils. The following list of tests with respective quantities was completed:

<u>Test</u>	<u>Quantity</u>
Moisture and Organic Contents	4
Particle Size Analysis	4
Specific Gravity	4
Atterberg Limits	8
Consolidation	5
Triaxial Shear (UU Test)	8

Laboratory tests were generally conducted in accordance with ASTM procedures as noted on Figure C-1 in Appendix C.

4-02. LABORATORY TEST RESULTS

The laboratory tests noted above were conducted on TWTS and one block sample taken in the organic soils and the marine clay strata. The test results are summarized in Table I, and are presented graphically on Figure 5 - Engineering Parameters of Organic and Clay Soils. Plotted results of the consolidation, triaxial shear and gradation tests are included in Appendix C.

The test results indicate similar properties to those assumed in the preliminary analyses by the USACE. One exception is the results of the consolidation and strength testing of the marine clay soils conducted for this study. These results indicate that the clay is overconsolidated, with maximum past pressures varying from approximately 9 tons per square foot (tsf) at El. -30, to 5 tsf at El -50. The undrained shear strength of the clay from the UU tests varied from 0.7 to 1.5 tsf.

The test results for the organic soils are variable, as was previously anticipated. Laboratory classification results indicate the samples tested are organic clay or peat, with higher plasticity than determined by visual/manual procedures conducted in the field during borehole sampling. The undrained shear strength from UU tests and FVST's ranges from 0.1 to 0.6 tsf, and averages approximately 0.3 tsf after correcting for plasticity.



V. SOIL AND WATER CONDITIONS

5-01. GENERAL

Roughans Point is located to the east of Young's Hill and Beachmont, two drumlins which are characteristic of the local topography. The drumlins rise above the local salt marshes or areas filled for development. Soils typical of the glacial, marine, marsh, and beach depositional modes were all encountered in the subsurface explorations, and are discussed below.

5-02. SUBSURFACE SOIL CONDITIONS

The subsurface explorations revealed the following soil sequence, listed in order from the ground surface downward:

- o Fill
- o Beach Sands
- o Organic Soils
- o Marine Clay and Sand
- o Glacial Till

The above sequence reflects the order of occurrence of the units below ground surface, however, one or more of these units may be absent at specific locations. The various strata encountered in the test borings and test pits conducted for this study are discussed below in reverse order to reflect their sequence of deposition. A generalized subsurface profile is shown on Figure 2, which includes previous explorations as well as the borings completed for this study.

The 1989 series borings were conducted to confirm previous data, and to obtain samples for laboratory testing. The soil descriptions which follow are based on the samples and observations from the 1989 series borings. Strata thicknesses were generally determined from the 1987 and 1989 borings. The 1936 borings were used only to confirm general trends.

A. Glacial Till

Glacial till, a dense, poorly sorted sediment, was deposited by glacial ice. This material is composed of a heterogeneous mixture of mineral particles and rock fragments ranging in size from clay to boulders. The glacial till encountered at B89-1, B89-2, and B89-5 generally consists of dense to very dense silty fine sand,



with varying amounts of clay, coarse sand, gravel, cobbles and boulders. The deposit was not fully penetrated in any of these borings. The top of the glacial till was encountered at depths ranging from 29 to 49 ft. below existing ground surface.

B. Marine Clay and Sand

Following the retreat and stagnation of the glacial ice sheet, a rise in sea level inundated the area with marine water. Quantities of silt, clay and fine sand sized particles settled out of suspension to form marine deposits which blanket the site. Two sub-strata have been identified within the marine deposits, as follows:

Marine Clay: The predominant marine clay sub-strata consists of a medium to hard, yellow to gray silty clay, with frequent fine sand partings and seams, and occasional coarse to medium sand and fine gravel.

Marine Sand: The marine sand sub-unit consists of dense, gray coarse to fine sand, trace fine gravel and silt, and was encountered in B89-5 only.

The marine deposits are frequently interbedded with partings, seams and layers of the two sub-strata described above. The total thickness of the marine deposits encountered in the 1989 test borings varied from 3.5 to greater than 36.5 ft.

C. Organic Soils

Organic soils were deposited in a still water environment over the marine deposits. The organic soils are a heterogeneous and highly variable deposit, both in terms of gradation and consistency. Two sub-strata have been identified within the organic soils layer:

Organic Clay and Silt: This sub-layer consists of very soft to medium, gray organic clay and silt, with varying amounts of fibrous peat, fine sand, occasional gravel, shells and other organic matter. The organic clay and silt encountered in the 1987 and 1989 series borings varied in thickness from 0 to 23.5 ft. and with an average thickness of approximately 6 ft.

Peat: This deposit consists of very soft to stiff, brown to black, clayey to fibrous peat, with varying amounts of organic silt, shells, wood and other organic



matter. The peat thickness encountered in the 1987 and 1989 series borings varied from 0 to 14 ft. with an average thickness of approximately 5 ft.

D. Beach Sands

These granular deposits were generally encountered overlying the organic soils. They consist of medium dense, coarse to fine sand, with varying amounts of silt, gravel, and occasional cobbles. Beach sands were encountered at the test pits, and at borings B89-1, B89-4, and in B89-5. The observed thicknesses varied from 1.5 to 6.8 ft.

E. Fill

The fill overlying the site was encountered in B89-1 through B89-5. The three borings drilled on the west side of the seawall encountered the backfill placed following construction of the wall. The observed backfill ranges from loose to very dense coarse to fine sand, with clay, silt, gravel, cobbles and boulders in varying amounts, to medium to hard silty clay, with sand and gravel. Occasional construction debris, consisting of concrete, asphalt, crushed stone, and glass was also encountered. The range in SPT "N" value and difficult drilling conditions may be more a result of the cobble or boulder content of the fill, than the actual density or consistency of the backfill.

The riprap fill encountered on the east side of the wall consists of sub-angular to sub-rounded boulders ranging in size from approximately 1 to 6 ft. diameter. Approximately 4 ft. of riprap was encountered in B89-2 and B89-4. Soil fill was also encountered below the riprap in B89-2, generally consisting of boulders and concrete fragments, possibly intermixed with former beach deposits, and totalling 3 ft. thick.



VI. ENGINEERING ANALYSES AND RECOMMENDATIONS

6-01. BACKGROUND

This study includes engineering analyses of previous calculations completed by the USACE; assessment of wall and slope stability, and settlement; recommendations of possible modifications to the existing wall; and discussion of construction considerations. These analyses are based on available historic data regarding wall design and subsequent repairs, the current information provided by the USACE with regard to the proposed construction, and the results of the field and laboratory investigations performed for this study.

It has been assumed that the original construction and 1972 repairs were generally completed in accordance with the available plans and profiles. Although historic construction records are not available, observations of the existing conditions of the exposed seawall and in the seawall test pits generally support this assumption with the exception of the elevation of the lip on the face of the seawall.

Additionally, the analyses were based on field and laboratory tests of samples taken at 5 locations over the 1700 ft. length of seawall. As was previously discussed, the shear strength and consolidation characteristics of the organic soils are highly variable. H&A analyzed the stability and settlement issues to evaluate several cases, based on the observed range of field and laboratory results.

6-02. PRELIMINARY ANALYSES

H&A reviewed the preliminary settlement, stability and downdrag analyses completed by the USACE, and provided to H&A. The preliminary USACE analysis was performed using soil strength and compressibility properties estimated using SPT "N" values, classification tests, and empirical relationships.

The H&A analysis of the seawall and berms is consistent with those presented in the calculations, in terms of applied loads and soils stratigraphy. The H&A analyses of settlement, stability and downdrag differ primarily as a result of additional information obtained from the field and laboratory tests. Detailed discussion of the analyses follow.



6-03. STABILITY ANALYSES

Stability analyses were completed to assess the existing condition of the seawall, as well as the potential effects of the proposed construction. Details of the proposed construction sequencing and the final seawall and revetment geometry were provided by the USACE. It is understood that the design life of this structure may be 50 to 100 years, with periodic maintenance. The issues addressed include the stability of the seawall as a retaining structure, and the slope stability of the subsurface soils during excavation and construction of the proposed revetment.

A. Wall Stability

Based on the available information, the seawall appears to be stable in its present condition. Based on spot elevations at exploration locations, the top of the concrete cap appears level, indicating minimal differential settlement at least since the 1972 repair. Surveyed elevations at the 6 locations vary from El. 17.47 to 17.70. As previously discussed, the steel sheet piling is in good condition at the two locations exposed by test pits TP89-4 and TP89-5.

The concrete portion of the seawall has many closed cracks. The cracks, observed by H&A and the USACE personnel during field visits, are frequent along the length of the reach. They are generally vertical, closed to approximately 1/16 in. width and from 4 to 10 ft. long. There is generally no visible spalling or deterioration of the concrete.

The structural stability of the wall was evaluated for the construction condition requiring excavation to El. -1, prior to placement of the proposed revetment. The analysis was performed using lateral soil pressures without any surcharge loading on either side of the wall. The stratigraphy was varied to consider the average depth of organic soils typical of most of the reach, as well as the thicker stratum observed at boreholes B89-4 and B89-5.

Results of a plane strain analysis of the cantilevered steel section without consideration of the concrete indicate that the wall would be stressed to approximately 40 to 44 kips per square inch (ksi) if long span excavations are opened in front of the wall. These results are based on a range of shear strengths for the organic soils from 0.15 to 0.45 tsf. It is anticipated that the



yield strength of the steel sheet piling is 36 ksi. Therefore, this analysis indicates that overstressing of the steel sheet piling could occur.

Figure E-1 in Appendix E illustrates the general section considered and the results obtained. Further, the point of maximum stress is below the concrete section of the wall, reducing the beneficial effects of its added stiffness in the plane strain condition. As will be discussed in more detail in Section 6-06, a staged construction sequence of shorter excavated spans would reduce the bending stresses in the wall.

B. Slope Stability

The stability of the subsurface soils was evaluated for support of the proposed revetment during construction and upon completion. The analyses were based on the configuration of the proposed revetment and the construction sequence described by the USACE as shown on plans which were provided (Ref. 4). Slope stability analyses were performed using the Geoslope computer program which assumes plane strain conditions.

Soil stratigraphy and strength characteristics were developed from the subsurface explorations and the field and laboratory test results. Several cases were considered, due to the strength variability of the soils tested. A general profile was used to check for deep or shallow failure surfaces. In general, thickness of the organic soils stratum was not a controlling factor.

It is understood that USACE requires a minimal factor of safety of 1.4 for the final construction case. During construction, a minimal factor of safety of 1.3 is required.

The H&A slope stability analyses indicate that although the revetment should be stable in the final condition, the proposed construction of a working berm, during and immediately after excavation of the toe berm creates a potentially unstable condition. The slope stability decreases with lower soil strength and higher construction surcharge loading. The stability was analyzed for a range of shear strengths in the organic soils, with varied surcharge loads. The results of this analysis are plotted on Figure 6 - Summary of Stability Analyses, Construction Case. Plotted results of the Geoslope analyses are included in Appendix E.



The USACE has indicated that a high strength geotextile may be included in the revetment design for purposes of soil segregation and reinforcement. For areas where the shear strength of the organic soils is less than 0.25 tsf, the H&A analyses indicate the slope would be unstable without a geotextile. Locally unstable areas may be stabilized using a relatively high strength geotextile. Alternative construction sequencing, such as limiting the width of the toe berm excavation parallel to the existing wall or excavation of the toe berm prior to placing the working berm, may be options for improving the stability of the slope during construction.

6-04. SETTLEMENT

Settlement of the seawall, the proposed revetment, and the adjacent areas was evaluated as a result of the increased loads due to the proposed improvements. The total settlement, resulting from initial elastic, primary consolidation and secondary compression, was evaluated at several locations for the final constructed condition.

Analysis of one-dimensional primary consolidation was performed using the TCON computer program. Elastic and secondary analyses were performed by hand calculation. The compressibility parameters were determined from laboratory tests. The laboratory values were compared to additional field and laboratory data from H&A files. The soil profiles were varied to consider both extreme and average conditions, as observed in the subsurface explorations. The estimates of ground settlement neglect the presence of the steel sheet piling.

A. Revetment

It is anticipated that the settlement of the proposed revetment will be highly variable, based on the heterogeneous nature of the organic soils. The average elastic and primary consolidation settlement at the crest of the completed structure is estimated to vary from 3 to 6 ft., and average approximately 4 ft. The average time for completion of primary consolidation is estimated to be 8 to 12 years. Secondary settlement is estimated to average 2 ft., and may occur over the next approximately 50 years following the completion of primary consolidation. Profiles and plotted results of the settlement analyses are included in Appendix F. The profiles shown in Appendix F considered an average case for the Reach E, and two extreme conditions of thicker organic deposits.



Settlement is expected to be negligible at the extreme north end of the reach, where no organic soils were encountered at borehole B89-1.

B. <u>Seawall</u>

The settlement of the seawall, due to downdrag loads imposed by settlement of the adjacent soils, was addressed with a historical perspective of previous construction and ground movement. Based on the current technical understanding of the downdrag phenomenon (Ref. 5 and 6), the magnitude of the downdrag forces is a function of the relative movement between the soil and the steel sheeting, as well as the effective soil stress and the shear strength of the soil. Review of previous case studies discussed in technical literature indicates that maximum soil-pile adhesion is developed with relatively small differential movements (less than 0.25 in.). Additionally, the upper limit cannot exceed the structural capacity of the pile, or the frictional resistance of the soil. If either of the two are exceeded, the pile will move downward relative to the soil, resulting in unloading of the downdrag forces, until equilibrium is achieved.

Analysis of the previous construction indicates that the wall backfill and riprap caused sufficient settlement to generate maximum downdrag forces on the steel sheet piles. The previous loads have apparently reached equilibrium, based on the wall performance since 1972. The proposed revetment will cause additional ground settlement, as noted above, and downdrag loads on the wall. The wall will therefore undergo incremental loading and yielding to maintain equilibrium. The maximum wall movement will be less than the settlement of the adjacent ground (estimated to be up to 10 inches of primary consolidation settlement at the seawall) and will probably average approximately 4 to 8 inches. Maximum downdrag force conditions will occur during primary consolidation, and will not be significantly changed by secondary compression.

C. Adjacent Structures

The two structures located closest to the wall, 11 and 12 ft. west, respectively, are at 90 Broad Sound Avenue and 7 - 9 Coral Street. Settlement estimates were made for the ground adjacent to these residential structures to assess the potential effects of the proposed construction. Records of foundation construction were not available for these two structures; although, it appears that the structures are supported by either shallow spread footings or timber piles.



Estimates of ground settlement at 10 feet west of the seawall do not exceed approximately 2 inches. Differential settlement on the order of 2 inches would cause cosmetic damage to each structure, and possible structural damage if significant previous settlement has occurred.

The masonry structure at 90 Broad Sound Ave. already exhibits numerous cracks which indicate previous differential settlement of its foundation. According to discussions with USACE personnel, they have data concerning the cracks in this structure. No apparent cracks were observed during this study in the wood frame structure at Coral Street.

6-05. WALL MODIFICATIONS

Based on the H&A field observations and engineering analyses, it appears that the wall is stable in its present condition. The proposed construction will exert additional forces on the wall due to the excavation for construction and subsequent backfilling and construction of the revetment. Impacts of the construction are considered in Section 6.06.

It is understood that the USACE has performed a cost/benefit ratio study as part of the consideration of capping the existing seawall. The objective of the cap is to increase flood protection. Additionally it may be possible to raise the wall height to account for settlement due to the proposed revetment. The settlement estimates in this report should be incorporated into the USACE design consideration of the cap height.

If the final design includes capping the wall, consideration should be given to the use of pre-cast concrete elements that could be set in place on top of the existing wall and pinned to the existing structure. A cap of pre-cast units could be less expensive than a cast-in-place cap. Also, due to the limited access, the pre-cast cap could be built from the sea side of the wall if necessary.

The existing concrete lip at the base of the wall should be removed as part of the improvement to reduce the effects of the final construction. The backfill for the proposed revetment will exert vertical loads on the wall when the underlying soils consolidate. The magnitude of these loads can be reduced by removing the lip. The previously described analyses assumed that the lip would be removed.



For budgetary purposes, the cost for cutting off the lip is estimated to be approximately \$60 per lineal foot, as indicated by local contractors. This cost reflects the geometry observed at the two test pit locations along the wall, a 3 to 4 hour daily work window to account for tidal fluctuations, and access to the lip provided by the excavation contractor. The estimated cost, which does not include general contractor overhead factor or subcontractor mark up, should be verified during the final design cost estimate.

As discussed with the USACE, vertical joints cut into the wall to reduce cracks are not recommended. Joints for that purpose must extend to approximately 3/4 through the thickness of the wall be effective. Joints may be more detrimental by exposing the steel and concrete to corrosive elements.

6-06. CONSTRUCTION CONSIDERATIONS

A. <u>General</u>

This section provides general comments on construction considerations and foundation treatment. This section is written primarily for the engineer having responsibility for preparation of plans and specifications. Since it identifies potential construction problems related to the seawall and earthwork, it may also aid the personnel who monitor the construction activity.

Prospective contractors for the project should evaluate potential construction problems on the basis of their own knowledge and experience, taking into account their proposed construction methods and procedures.

Excavation activities and lateral earth support (if required) for the construction should conform to the requirements of OSHA and all other applicable federal, municipal, and state regulatory agencies.

B. Excavation and Lateral Earth Support Requirements

The construction of the proposed revetment was evaluated for the construction sequence proposed by the USACE, and for the general range of subsurface conditions and laboratory test results obtained for this study (Ref. 4). It is understood that the preliminary USACE construction sequence consists of excavating to approximately El. -1 along the face of the existing seawall, placement of a high strength geotextile, and backfilling to approximately



El. 6 to create a working berm. The working berm will be constructed prior to excavation for the toe berm. As discussed in the stability analysis section of this report, the proposed revetment sequence may be unstable at various stages of construction in some areas.

To best utilize the knowledge and expertise of the contractor, the contractor should propose excavation and backfill schedules and sequences, together with supporting design calculations for review. The contractor's design should consider the variable nature of the subsurface soils, potential effects of surcharge loads appropriate for the proposed equipment, and other factors.

C. Protection of Adjacent Structures

As previously discussed, the proposed construction may lead to instability of the existing seawall, and may also impact the structures adjacent to the seawall. Therefore, care must be taken by the contractor to minimize any adverse effects on these existing structures. It is recommended that an observational approach be taken to the construction sequencing, and that the seawall and adjacent structures be monitored throughout the construction activities. Provisional corrective actions should be established so that they may be implemented if necessary, or the construction sequence may be revised to achieve the desired results.

To aid in this effort, it is recommended that a series of reference points be installed on the existing structures, seawall, and the adjacent ground for purposes of obtaining both settlement and horizontal offset data during construction. The points should be established prior to any excavation, and should be monitored regularly throughout construction, or as necessary based on an evaluation of the data obtained. A preconstruction survey of the adjacent structures is also recommended to document present condition and to identify structural deficiencies which may be of concern during the new construction.

D. Observational Approach

An observation approach should be used to monitor construction and performance of the seawall and adjacent structures. Limited reaches along the wall should be excavated and vertical and lateral wall, ground and building displacements should be surveyed.



For example, initial excavation should be limited to a maximum width of 25 ft. parallel to the wall. If corresponding wall and structure displacements are less than the acceptable criteria set by USACE, the excavated width of the next section may be increased. The contract documents should be written to provide for a conservative approach with allowances for change during construction based on demonstrated performance by the contractor and observed wall movement. The allowable width of excavation should also consider the proximity of adjacent structures.



VII. CONCLUDING COMMENTS

This report has been prepared for specific application to the subject project in accordance with generally accepted geotechnical engineering standards. No other warranty, expressed or implied is made. The studies were completed in part using available information regarding existing and proposed structures and construction procedures. In the event that changes in the design or existing conditions are encountered, the conclusions and recommendations in this report should be reviewed and the recommendations modified or verified in writing by H&A.

The recommendations are also based in part upon the data obtained from the referenced subsurface explorations. The nature and extent of the variations at and between explorations may not become evident until revealed during construction. If variations then appear evident, it will then be necessary to reevaluate the recommendations in this report.



VIII. REFERENCES

- Massachusetts Department of Public Works drawing No. ACC.
 01621-A, "Proposed Sea Wall, Roughans Point, Revere," dated
 October 1936.
- USACE drawing No. SK-213, "Restoration of Sea Wall, Roughans Point," dated August 1972.
- Engineering Log Profiles provided by the USACE, untitled, undated.
- 4. USACE draft "Civil Layout Plans," received 9 January 1990.
- 5. Baligh, Mohsen M., and Vivatrat, <u>A Manual on Prediction of Pile Downdrag on Eng Bearing Piles</u>. Department of Civil Engineering, Massachusetts Institute of Technology, (Cambridge, Massachusetts, 1975).
- 6. Fellenius, Bengt H., "Downdrag on Piles in Clay due to Negative Skin Friction," <u>Canadian Geotechnical Journal</u>, The National Research Council of Canada, Volume 9, No. 4, November 1972, pp. 323-337.
- 7. Bjerrum, Laurits, "Embankments on Soft Ground," <u>Proceedings of the Specialty Conference on Performance of Earth and Earth-Supported Structures</u>, Purdue University, Lafayette, Indiana, ASCE, June 1972, pp. 1-54.

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	 (Recovery = 23.0 in.) 											· — — -
efer to	Refer to figure "General Geotechnical Laboratory Soil Test Program Notes" (H&A Form No.550) for definitions and test procedures,	nnical Lab	oratory	Soil Test F	rogram Notes" (H&A Fe	orm No.550) for def	initions a	and test	t procedures,	H&A FORM N	H&A FORM NO.502 AUG.1989

attached as figure C-1, Appendix C. Refer to Appendix C for plotted results of oedometer, triaxial and gradation tests.

FROLECT: Road-busetts FROL	HALEY	HALEY & ALDRICH, INC. Consulting Geotechnical Engineers,	eers,			TABLE I (continued) SUMMARY OF GEOTECHNICAL LABORATORY TEST RESULTS	TABLE I (continued) ECHNICAL LABORATORY	rued) TORY TEST	. RESULTS			PAGE 2 OF	٥
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and 35.8 uu6 29.0	42.6 17.5 25.1 (122.4.) 0.82		silty CLAY, trace	32.6	_	29.8	_	_	_	0.85		0.93			
36.1 25.6 42.6 17.5 25.1 (122.4) 36.1 27.5 0.20 0.20 0.20 1.0 in.)	42.6 17.5 25.1 ((122.4) 0.82 1.04 0.93 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0		fine gravel and	35.8	900	29.0	_	_	125.0			_		1.548	_
36.1 25.6 42.6 17.5	42.6 17.5 25.1 (122.4) 0.82 1.04 0.93 0.82 0.20		coarse sand	_	_	_	_	_	_			_		[DND]	
36.1 27.5 0.82 1.04	0.20 0.82 0.93			_	-	25.6		25.1	(122.4)			_		_	_
	ogram Notes" (H&A Form No.550) for definitions and test procedures.			36.1		27.5				0.82		0.93			
[Recovery = 21.0 in.)]	ogram Notes" (H&A Form No.550) for definitions and test procedures.		_									_			
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.		_	_	_	_	_	_	_			_			
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.				_	_			_			_		_	_
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.														
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.														
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.				-	_			_			_			
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.			- -											
	ogram Notes" (H&A Form No.550) for definitions and test procedures.				. —	- —	- —	_				- —			
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.				_			_						_	
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.														
(Recovery = 21.0 in.)	ogram Notes" (H&A Form No.550) for definitions and test procedures.			· — ·					· —						- -
	ogram Notes" (H&A Form No.550) for definitions and test procedures.		 (Recovery = 21.0 in.)												
	ogram Notes" (H&A Form No.550) for definitions and test procedures.						-	_							

Consult	Consulting Geotechnical Engineers,	eers,			IABLE I (CONTINUED) SUMMARY OF GEOTECHNICAL LABORATORY TEST RESULTS	IABLE I (CONTINUEG) ECHNICAL LABORATORY	rued) NTORY TEST	RESULTS				PAGE 4 OF	٥
Geol	Geologists and Hydrogeologists	sts										FILE NO.	10259-01
					PROJECT: Rough	Roughans Point Revere, Massachusetts	setts					DATE:	January 1990
EXPL.		DEPTH	TEST	NATURAL	ATTERBERG LIMITS (%)	TOTAL	INDE	INDEX STRENGTH (tsf)		STRESS HISTORY	ORY	UNDRAINED	
SAMPLE NO.	SAMPLE DESCRIPTION	[ELEV] (feet) 	2	— CONTENT	Liquid Plastic Limit Limit Ip wL wp	WEIGHT (pcf)	<u> </u>	» «	PP/2	- PRECONSOL. PRESSURE(tsf) [test quality]		STRENGTH, cu (tsf) [test type]	REMARKS
B89-3 U1		22.0 to 24.0				(89.3)							
	Soft dark gray ORGANIC CLAY, Little fine sand, with shell fragments	22.1	LUJ	42.4 48.7 47.0	 62.0 27.8 34.2 37.4 oven dried	- 108.8 - 108.8 - 1	0.14		0.22			0.266 [UUC]	 - L01=4.1%
		22.5	0ED1	55.2		102.8	0.24	0.31	0.26	0.9 [Fair]	0.202		
		22.9		49.8			0.19	0.32	0.27				
		23.1		49.1			0.16	0.30	0.28				
		23.2		46.2			0.16))	0.25		 ·		
											_		

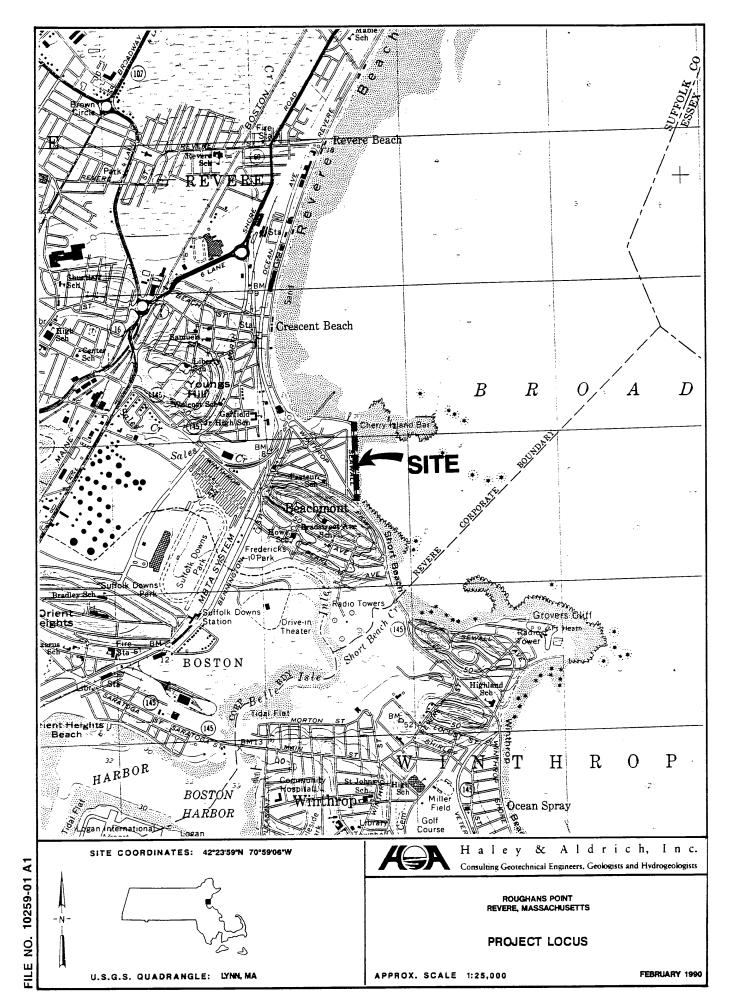
Consult	Consulting Geotechnical Engineers,	eers,			SUMMARY OF GEOTECHNICAL LABORATORY TEST RESULTS	GEOTECHN)	CAL LABOR	TORY TEST	RESULTS					
Geolc	Geologists and Hydrogeologists	sts										FILE NO.	No. 10259-01	- i
					PROJECT:		Roughans Point					DATE:		January 1990
						Rever	Revere, Massachusetts	usetts						
EXPL.		DEPTH	1661	NATURAL	ATTERBERG LIMITS	LIMITS	TOTAL	INDE	INDEX STRENGTH	= -	STRESS HISTORY	UNDRAINED	INED	
SAMPLE	SAMPLE DESCRIPTION	CELEVI		CONTENT	 Liquid Plastic	tic	WEIGHT		(TST)		PRECONSOL	SHEAR		DEWADIYO
NO.	_	(feet)		8	Limit Limit	nt Ip	(pcf)	_	AS.	PP/2	sf)			SYNC
					낲	_			œ		[test quality]	. - -	[Abe]	
889-3		42.0 to					(7.727.7)							
3		44.0		. —	.									
	 Soft to stiff	1 42.0		26.8										
	gray green silty	42.1		22.9				0.52		0.56				
	CLAY, trace fine	42.2		23.6				0.57		0.68				
	sand, with occasional	_	nu2	25.3			126.5					1.138	 	
	sand partings and	_	-		_		_			_		[Onc]	_	
	gravel	42.6	- -	7.0				0.63	0.83	0.69		_	_	
				17.2	71 7 22	0 71 0 71	7,77		0.18					
		- & C7		2.1.		0.0	(0.02!) -	-	9					
	-			; ;				: :	25.00	- 78. 0.				
	_	73.0		28.7				0.41	;	0.92				
	_	43.1		23.2			_	0.85		0.83				
	_	43.2		25.4			_	0.92		0.91		_	_	
		43.3	OED2	28.5			124.5				8.7 0.	0.144		
	Medium stiff gray	_			_		_			_	[Fair] 0.0	0.006	_	
	clayey (fine) SAND	43.5		22.5			(128.6)					_		
		43.8		21.7	_			0.41	0.70	0.80		_	_	
		74.0		20.1	_			73	0.11					
				- -										
	(Recovery = 24.5 in.)			- -								·	- -	
										_		_	_	

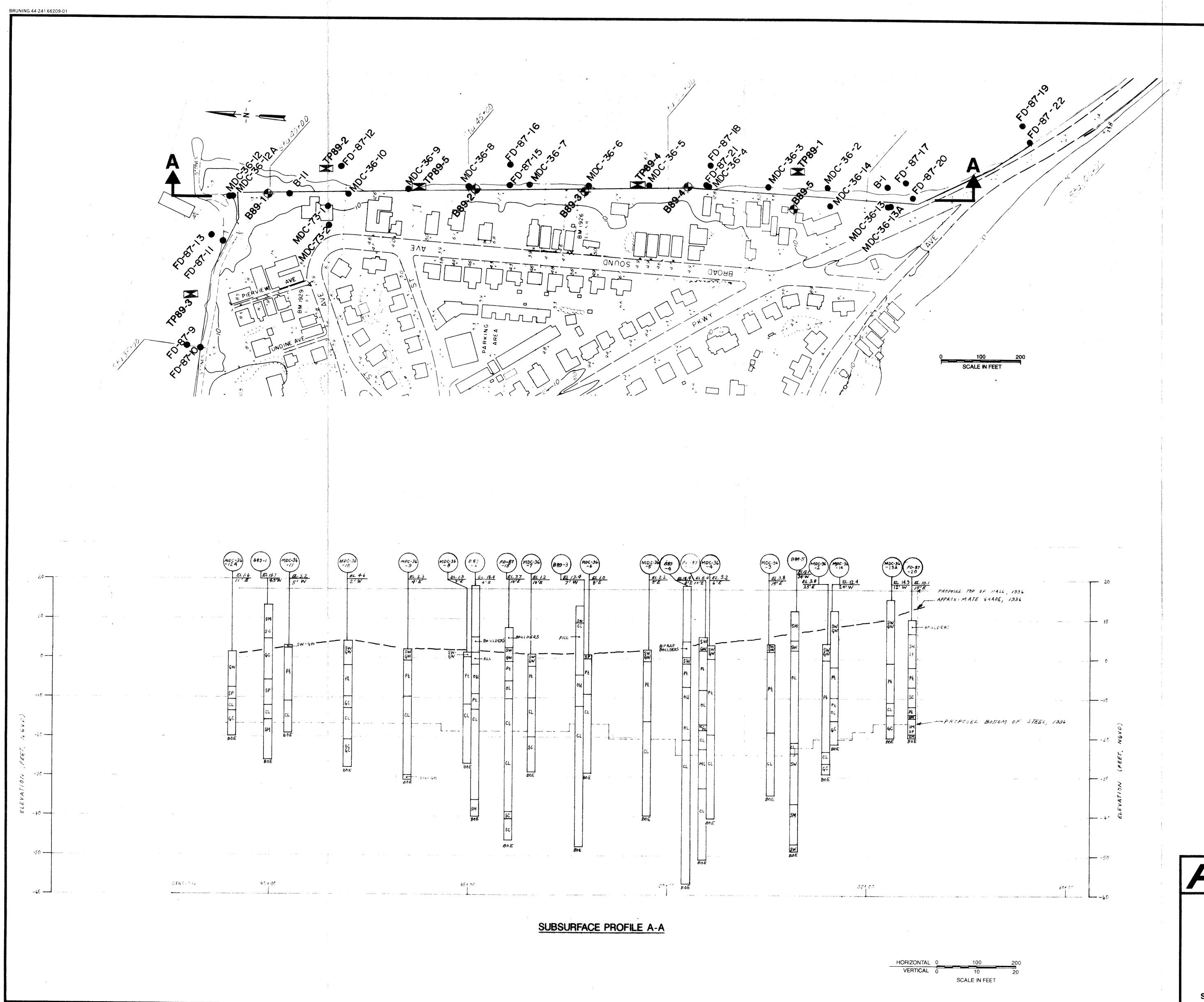
PATE: STRESS HISTORY UNDRAINED	mater & ALDKich, inc. Consulting Geotechnical Engineers,	Engineers,			SUMMARY OF GEOTECHNICAL LABORATORY TEST RESULTS	IABLE I (CONTINUED) ECHNICAL LABORATORY	rued) TORY TEST	RESULTS			PAGE 6 OF	٥
SAMPLE DESCRIPTION TEST MATURAL ATTEREBEG LINITS TOTAL INDEX STREAGH STRESS HISTORY UNDOALHED	Geologists and Hydrog	eologists									FILE No.	10259-01
SAMPLE DESCRIPTION CERTON MATURAL ATTERBERG LIMITS 1707AL 1100EX STREIGHT STRESS HISTORY UNDEALNED CERTON MATURAL						ans Point e, Massachu	setts				DATE:	January 1990
Striff dark brown 6-1 133.0 0.58 0.66 0.68 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64 0.64				NATURAL NATER CONTENT CONTENT	15	TOTAL TOTAL UNIT WEIGHT Cpcf)	INDEX	STRENGTH tsf) SV PP//	- : 3 3 2	§	UNDRAINED SHEAR STRENGTH, cu (tsf) [test type]	REMARKS
	<u> </u>	 	<u> </u>	133.0 146.8 121.7 128.6	113.2 oven drie	<u> </u>	0.65		ğ 	7,00.0	0.645 (WC)	

Concuting Beatchmids Equipment Status Submost of GOTECHHICAL LABBARIUS FILE No. 1029-01	Consul	ting Cantachaical Casis										2	•
PROJECT: Roughmer Point Revere, Missachuaetts PROJECT: Roughmer PROJ		ting deotecimical Engin	eers,			SUMMARY OF GEOTECHNIC	CAL LABORA	TORY TEST	. RESULTS				
Name Property Revery R	Geol	ogists and Mydrogeologi	sts									FILE NO.	10259-01
SWPLE DESCRIPTION CELPTY TEST WATURAL ATTERBEGG LIMITS TOTAL TOT							as Point					DATE:	January 195
SAMPLE DESCRIPTION TEST MATERIAGE LIMITS I/ONT I/ONT C(\$\$) I/ONT						Revere,	, Massachu	setts					•
Creecol Marcol Counter Counter Counter Counter Counter Creecol Counter Creecol Creec	KPL.		_	_	NATURAL	ATTERBERG LIMITS	TOTAL	INDE	X STRENG	E	STRESS HISTORY	UNDRAINED	
SAMPLE DESCRIPTION Cleet) Ko. CONTENT Liquid Plastic MeTidit Properties Content Cleet Metidity Metidity Cleet Metidity Metidity Cleet Metidity Metidity Cleet Metidity Cleet Metidity Cleet Metidit	ď	_	DEPTH	TEST	WATER	(%)	TIND		(tsf)			SHEAR	
(feet) (%) Limit Limit p (pef) TV SV PP/2 PRESSME(fef) RR Cu (fef) Limit Limit p R (feet quality) (feet type)	AMPLE	SAMPLE DESCRIPTION	[ELEV]	- No.		Liquid Plastic	WEIGHT					STRENGTH	REMARKS
22.0 to	ď	_	(feet)	_	8	Limit	(pcf)	2	S			cu (tsf)	
Soft to medium stiff 22.1 76.3							_		œ		[test quality]	[test type]	- —
Soft to medium stiff 22.1 76.3	89-4		22.0 to				1 (8 5)						
Soft to medium stiff 22.1 76.3	17		7,7				 3 						Sample not
22.2 79.6 76.3 76.3 76.3 76.4 22.2 79.6 22.2 79.6 22.3 79.6 22.5 74.4 77.5 61.9 85.8 (98.6) 0.12 0.12 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0	;												tested due
22.2 79.6 0.30 0.55 0.46 22.3 78.6 22.3 78.6 22.3 78.6 22.5 74.4 22.5 74.4 22.6 96.9 22.7 99.5 22.8 199.3 22.8 199.3 22.8 199.3 22.9 120.4 22.9 120.6 22.9 120.6 22.9 22.8 190.4 22.1 22.8 190.4 22.8 190.4 22.8 120.6 22.9 22.8 120.6 22.9 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22.8 22			- -		' i								<u>t</u> o
22.3 78.2 0.30 0.55 0.46 0.23 0.55 0.46 0.25 0.45 0.12 0.12 0.12 0.12 0.12 0.12 0.13 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14		Soft to medium stiff	1.22	_	/6.3	_	_					_	disturbance
22.3 78.2		dark brown PEAT	25.2		9.6	_	_						from crack
22.5 74.4 0.23 0.56 0.55		with gravel	22.3		78.2		_	0.30	0.55	0.46			throughout
71.5 74.4 0.23 0.56 0.55 1.7.7 61.9 85.8 (98.6) 0.19 0.19 0.19 0.19 0.19 0.19 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20 0.20		_		_	_		_		0.12				sample
22.6 96.9 65.7 oven dried 0.26 0.62		_	22.5		74.4		_	0.23	0.56	0.55			<u> </u>
22.6 96.9 65.7 oven dried 0.26 0.62		_	_		71.5	61.9	_		0.19	_			11.01=2, 7%
22.6 96.9 0.26 0.62 22.7 99.5 0.40 0.49 22.8 109.3 0.40 0.68 22.9 120.3 0.40 0.68 22.9 170.4 0.31 0.50 23.0 110.4 0.34 0.48 23.1 116.5 (81.8) 0.41 0.54 23.3 86.9 0.29 0.38 23.5 75.7 0.29 0.55 23.5 75.7 0.29 0.49		_	_			65.7 oven dried	_						G=2.44
22.7 99.5		-	52.6		6.96		_	0.26		0.62			: - -
22.8 109.3 0.40 22.9 120.3 0.31 23.0 110.4 0.34 23.1 116.5 (81.8) 0.41 23.2 120.6 0.29 23.3 86.9 0.29 23.5 75.7 0.27 0.02			22.7	_	9.5		_	0.37		67.0			_
22.9 120.3		_	22.8		109.3		_	0.40		0.68			
23.0 110.4			22.9		120.3			0.31		0.50	_		
23.2 116.5 (81.8) 0.41		_	23.0		110.4	_	_	0.34		0.48			
23.2 120.6 0.29 23.3 86.9 0.29 23.5 75.7 0.27 0.34 			1.23.1	_	116.5		(81.8)	0.41		0.54	_		_
23.5 86.9 0.29 23.5 75.7 0.27 0.34			23.2		120.6	_	_	0.29		0.38			
23.5 75.7 0.27 0.34			23.3	_	86.9		_	0.29		0.55	_		
		_	23.5		75.7	_	_	0.27	0.34	0.49			
[Recovery = 20.0 in.)							_		0.02		_	_	
(Recovery = 20.0 in.)													
 											_		
(Recovery = 20.0 in.)												_	
		 (Recovery = 20.0 in.)											
							- -				_	- -	

Geologists and Hydrogeologists	rdrogeologi	sts						SOUTHWEIGHT OF BEOLEGISHINGS TO SEE MESOLES				
PL.										_	FILE NO.	10259-01
					PROJECT: Roughan	Roughans Point				_	DATE:	January 1990
					Revere,	Revere, Massachusetts	setts					
			_	NATURAL	ATTERBERG LIMITS	TOTAL	INDEX	INDEX STRENGTH	STRESS HISTORY	5	UNDRAINED	
		DEPTH	TEST	WATER	8	LINI	_	(tsf)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	<u>-</u>	SHEAR	
7-6-27	SAMPLE DESCRIPTION	(ELEV)	- NO.	CONTENT	Liquid Plastic	WEIGHT			- [PRECONSOL.	C8 SI	STRENGTH,	REMARKS
		(feet)	_	& _	Limit Limit 1p	(pcf)	2	SV PP/2	PRESSURE(tsf)		cu (tsf)	
1					FL ND			œ	[test quality]	<u>-</u>	[test type]	
		26.0 to								 -		
 Very soft t brown ORGAN with gravel		28.0	. <u>—</u> .			_				-		
brown ORGAN with gravel	o soft	7 %										
 with gravel	IIC CLAY	26.5		74.1			0.13	0.25				
-		26.6		72.2	. —		0.14	0.20		_	-	
_		7.92	_	6.43		_	0.10	0.21		_	-	
_		_		1.22	93.8 28.3 65.5	(97.2)				-		
_		_	_	_	54.8 oven dried	_				-	-	
_		26.8	OED4	1 59.0		101.3			0.45 0.	0.169	-	
			- i			_ ;			[Good] 0	0.024		
			Š	 		2.1%					0.132	
- —		27.3	-	53.8								
_		27.4	_	50.3		_	0.15	0.20			_	
										_		
- —											_	
		_	_			· —						
										_	_	
										- — -		
 (Recovery = 17.0 in.)	17.0 in.)	- -										

SAMPLE SAMPLE DESCRIPTION ELEV] No.	PRO NATURAL ATTER WATER Liquid CONTENT Liquid CONTENT Liquid 27.2 32.3 34.9 50.5 34.9 50.5 37.4 38.6	DECT: (%) (%) Plastic Limit WP 24.5	Roughans Point Revere, Massachusetts MITS TOTAL UNIT	INDEX STRENGTH (tsf) TV SV PP R 0.44 0.60	PP/2	STRESS HISTORY 	FILE NO. DATE: UNDRAINED SHEAR STRENGTH, cu (tsf) [test type]	10259-01 January 1990 REMARKS
DEPTH DEPTH	==	Revere, HRBERG LIMITS TO C(%) C C C C C C C C C	Point assachuset OTAL OTAL OTAL Cpcf) Cpcf] Cpcf) Cpcf] Cpcf]	1NDEX STR (tsf) 1V SV R 0.44 0.60	5/9 5.0 5.0	STRESS HISTORY 	DATE: UNDRAINED SHEAR STRENGTH, cu (tsf) [test type]	January 1990
DEPTH DEPTH	=	1p 1p 26.0	OTAL	INDEX STR (tsf) TV SV R 0.44	5/9 5.0 5.0	STRESS HISTORY	UNDRAINED SHEAR STRENGTH, cu (tsf) [test type]	REMARKS
	<u> </u>	24.5 26.0	114.8	0.44	6.0 8.0	5.0 [Good]		
				0.67	0.68 0.64 0.64		0. 709 CUUCI	
(Recovery = 23.0 in.)	· -	· 						





LEGEND:

DESIGNATION AND APPROXIMATE LOCATION OF BORINGS MADE FOR THE DEPARTMENT OF THE ARMY, NEW ENGLAND DIVISION, CORPS OF ENGINEERS (USACE), BY GUILD DRILLING CO., INC., DURING THE PERIOD 6 DECEMBER 1989 TO 26 JANUARY 1990.

DESIGNATION AND APPROXIMATE LOCATION OF BORINGS FD-87-20 MADE FOR THE USACE BY ATLANTIC TESTING LABS, LTD., DURING THE PERIOD JANUARY TO FEBRUARY 1987.

MDC-36-10 DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED PRIOR TO DESIGN OF THE PROPOSED SEA WALL IN 1936, BY THE MASSACHUSETTS DPW.

DESIGNATION AND APPROXIMATE LOCATION OF TEST PITS TP-89-1 MADE FOR THE USACE BY J. MARCHESE & SONS, DURING THE PERIOD 4 TO 6 JANUARY 1990.

LOCATION AND ORIENTATION OF SUBSURFACE PROFILE.

SURFACE ELEVATION (NGVD) OFFSET FROM SECTION LINE IN FEET, EAST, E, WEST, W

BORING NUMBER

INDICATES GENERAL CLASSIFICATION OF SOIL STRATA, IN ACCORDANCE WITH ASTM D 2487 AND/OR ASTM D 2488. REFER TO TEXT AND APPENDICES OF THIS REPORT FOR MORE DETAILED INFORMATION ON SUBSURFACE

STRATIFICATION LINE BETWEEN SUBSURFACE UNITS

BOTTOM OF EXPLORATION

CONDITIONS.

NOTES:

- 1. BASE PLAN FOR FIGURE 2 PREPARED FROM A USACE UNTITLED EXPLORATION PLAN, PLATE 5, SHT #7, UNDATED, (DATE OF PHOTOGRAPHY 2-7-81; CONTOUR INTERVAL 2 FT.; SCALE 1 IN. = 100 FT.).
- 2. PLAN LOCATIONS OF SUBSURFACE EXPLORATIONS DESIGNATED B89-1 THROUGH B89-5 AND TP89-1 THROUGH TP89-5 WERE DETERMINED BY H&A, BY TAPING FROM EXISTING SITE FEATURES. THESE EXPLORATIONS WERE MONITORED BY H&A PERSONNEL.
- BORING LOGS FOR B89-1 THROUGH B89-5 MAY BE FOUND IN APPENDIX A OF THIS REPORT. TEST PIT LOGS, PLANS AND SECTIONS FOR TP89-1 THROUGH TP89-5 MAY BE FOUND IN APPENDIX B OF THIS REPORT.
- 4. PROFILES AND STRATA CLASSIFICATIONS SHOWN FOR BORINGS MDC-36-2 THROUGH MDC-36-11; MDC-36-12A, MDC-36-13A, MDC-36-14; AND FD-87-15, FD-87-20, AND FD-87-21 WERE TAKEN FROM ENGINEERING LOG PROFILES PROVIDED BY THE USACE, UNTITLED, UNDATED. ADDITIONAL INFORMATION REGARDING EXISTING CONDITIONS AND PROPOSED CONSTRUC-TION IN 1936 WAS TAKEN FROM A MASSACHUSETTS DPW DRAWING ENTITLED "PROPOSED SEA WALL, ROUGHANS POINT, REVERE, " CONTRACT NO. 479, DRAWING NO. ACC. 01621-A, SHEET 1 OF 3 SHEETS, DATED OCTOBER, 1936.
- 5. REFER TO THE REPORT TEXT FOR A DISCUSSION OF THE SUBSURFACE CONDITIONS AND MORE DETAILED INFORMATION REGARDING SUBSURFACE EXPLORATIONS, AND APPENDICES FOR PRESENTATION OF SUBSURFACE AND TESTING DATA.
- 6. ELEVATIONS ARE IN FEET AND REFER TO NATIONAL GEODETIC VERTICAL DATUM.
- 7. LINES REPRESENTING CHANGES IN STRATA ARE BASED ON INTERPOLATION BETWEEN SUBSURFACE EXPLORATIONS AND MAY NOT REPRESENT ACTUAL FIELD CONDITIONS AT OTHER THAN SPECIFIC EXPLORATION LOCATIONS.



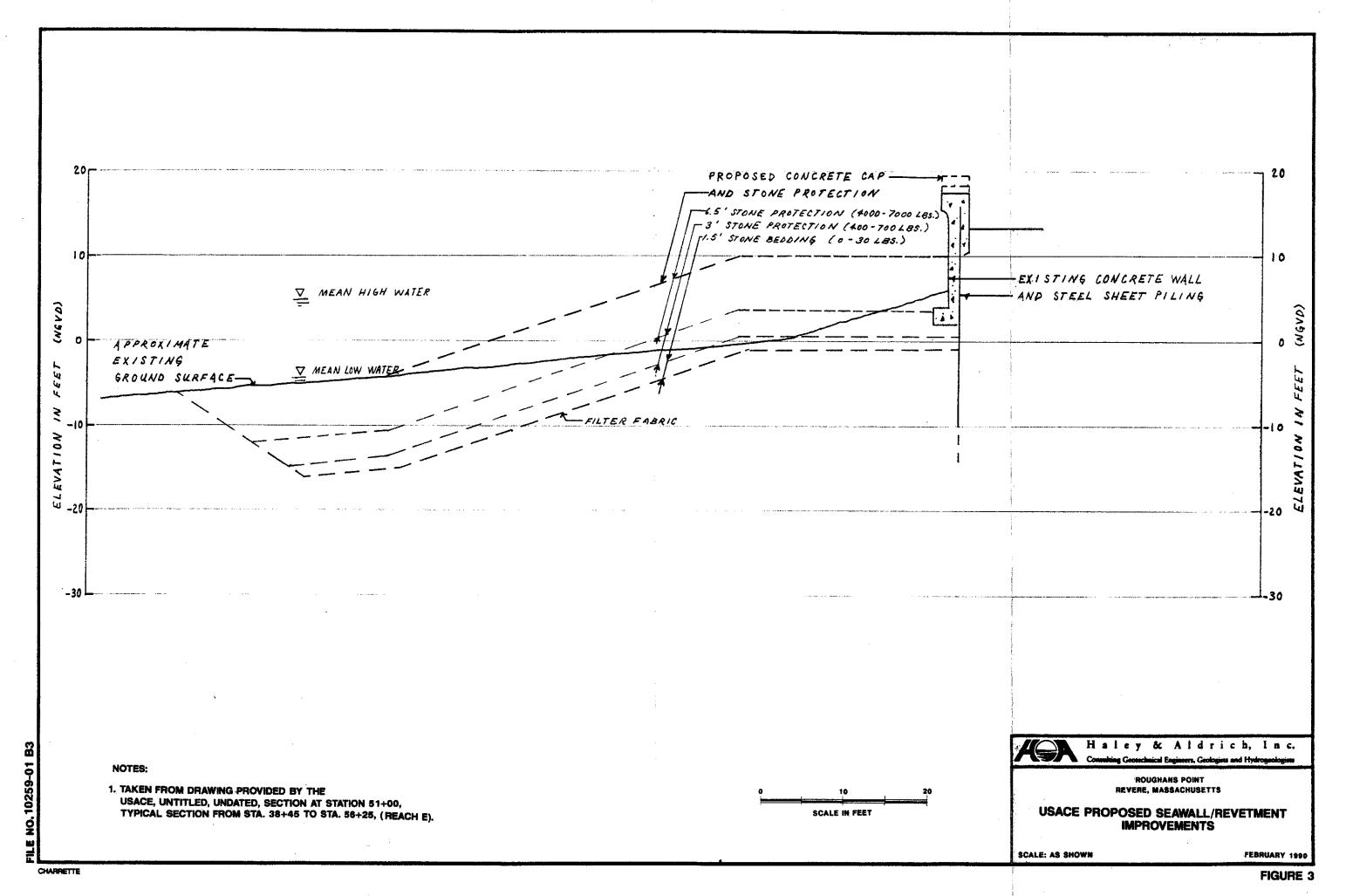
Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists Haley & Aldrich, Inc.

ROUGHANS POINT REVERE, MASSACHUSETTS

EXPLORATION LOCATION PLAN AND PROFILE

SCALE: AS SHOWN

FEBRUARY 1990



NOTES:

- 1. SECTIONS TAKEN FROM USACE DRAWING NO. SK-213, SHEET 1, ENTITLED "ROUGHAN'S POINT, RESTORATION OF SEAWALL," DATED AUGUST 1972.
- 2. REFER TO REPORT TEXT AND APPENDICES FOR ADDITIONAL INFORMATION REGARDING EXISTING CONDITIONS.



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ROUGHANS POINT REVERE, MASSACHUSETTS

APPROXIMATE CROSS SECTION OF EXISTING SEAWALL

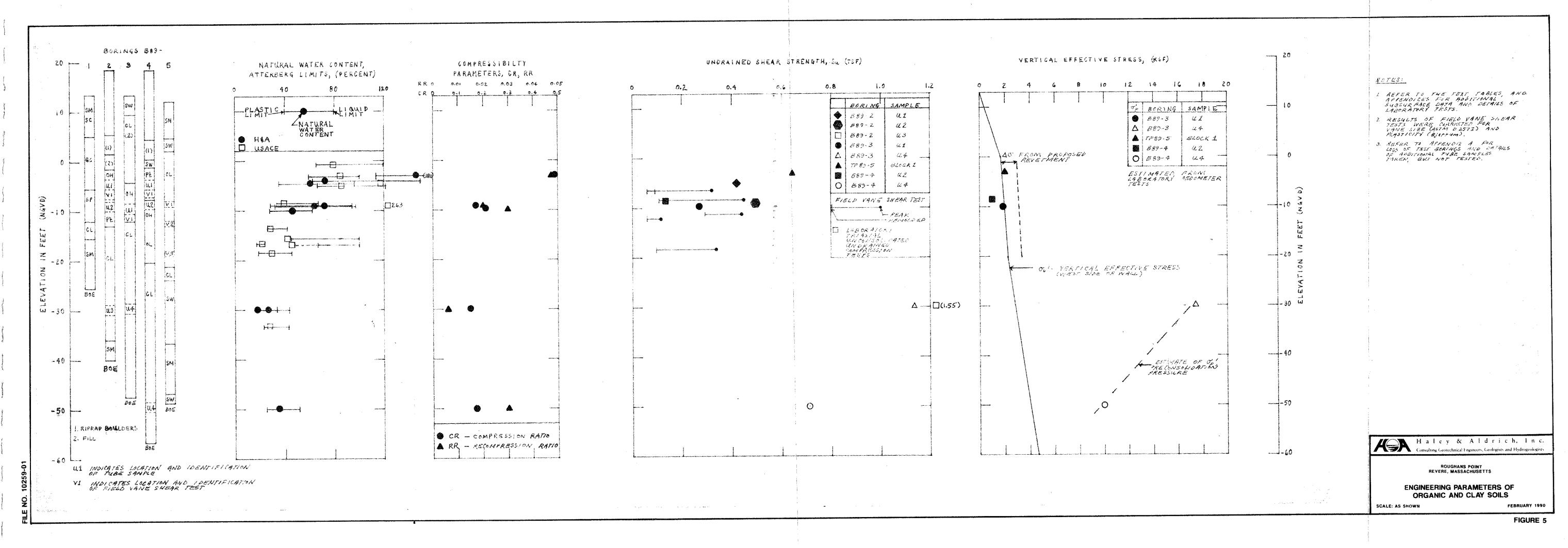
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FEBRUARY 1990

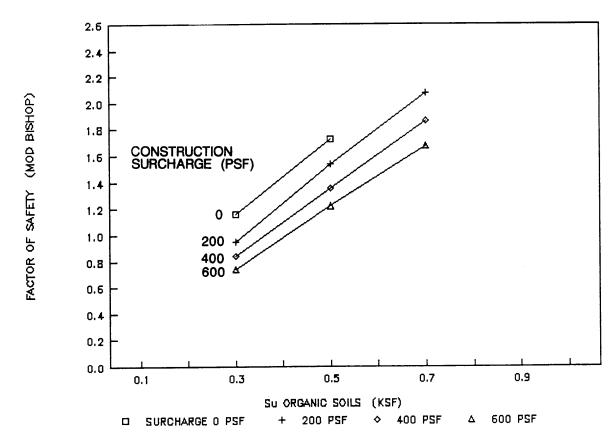
CHARRETTE

NO. 10259-01

FIGURE 4



FACTOR OF SAFETY V. SHEAR STRENGTH, Su



Hale Consulting G

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Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ROUGHANS POINT REVERE, MASSACHUSETTS

SUMMARY OF STABILITY ANALYSES CONSTRUCTION CASE

SCALE: AS SHOWN

FEBRUARY 1990

FILE NO. 10259-01 A6

MAKEPEACE 149093

FIGURE 6

APPENDIX A

Logs of Test Borings



	100 WATER STREET					DATE		
TO Haley & Aldr PROJECT NAME Sea Wa	ich, Inc.	IADDRESS	Cambride	ge, Mass	•	HOLE NO E		
REPORT SENT TO abov	re/Revere Beach	PR	OJ. NO. ———	1025901		OFFSET	······································	
GROUND WATER OBS		CASING	SAMPLER	CORE BAR.	START	<u>Dare</u> 12-06-8	<u>Time</u>	a.m

SA	MPLES S	ENT TO						703. NO JR JOB NO.	90-290	SURF. ELEV	13.7	NGV	/ D
At	14.0	UND WATER OBSE ofter chidal) after	Ноц	ırs	Type Size i D. Hommer Hommer	Wt.	CASING PW-HW 5" 4"	SAMPLE S/S 1-3/8 140# 30'	3"	START 12-06- COMPLETE 12-11- TOTAL HRS. BORING FOREMAN J. INSPECTOR W SOILS ENGR.	89 89 Te	xei bik	ra
L	OCATIO	N OF BORING											
ОЕРТН	Casing Blows per foot	Sample Depths From – To	Type of Sample	From	iows per (Sample	r To	Moisture Density or Consist.	Strata Change Elev.	Remarks included soil etc. Rock-o	ITIFICATION de color, gradation, Type of color, type, condition, hard- ne, seams and etc.	No.	SAMP	1
	1001		-	1	1-0 12	1 10	CONSIST.	0.2	Blacktop		110	+	11.6
		0.5'-2.5	D	12 26	1	23	Dense			se SAND, fine- el, tr. of Sil (SM)		24	'2
		4'-6'	D	8	3	4	Med. Stiff		with fine	lty CLAY mixed Sand, some el, Boulders (SC)	2	24	"I
		9'-11'	D	2 9	3	11	Stiff	_8 <u>.</u> 5'_	Yellow si coarse Gr	er return below 8. lty CLAY and avel, tr. of	3	24	"6
		@14 ^t	D	50	-0"		Hard		fine Sand	(Fill)	4	0"	0
		19'-21'	D	7	4	8	Med.	18.7'			5	24	"0
				10			Dense		Gray coar	(SP)			
-		24.5-25.	קי _כ	6	8			25.5'				10	
		25.5'-26			23	34	Hard	29.0'	Yellow CL	AY (CL)	6 6A	12	_
		29'-30.3	' D	71	70	L00-4	ļu n		little coa	y fine SAND, rse to medium el with cobbles rs (SM)	7	16	"12
 		34'-35.5	' D	14	48	54	16 (1			(Till)	8	18	"6
-								39.0'	Note: Boul (Refusal)	lder 37.5'-39'			
	GROUND S	39' SURFACE TO	D 10			USED _		CASING:	Bottom of	Boring 39.0' 27.5 Wash & S/	5 LO		eſ -

D=Dry C=Cored W=Washed UP=Undisturbed Piston TP=Test Pit A=Auger V=Vane Test UT=Undisturbed Thinwall

0 to 10% trace little 101020% 20to35% some 35 to 50% and

Cohesionless Density | 0-10 Loose 10-30 Med. Dense 30-50 Dense 50 + Very Dense

Cohesive Consistency 0-4 Soft 4-8 M/Stiff 8-I5 Stiff I5-30 V-Stiff

Earth Boring 39.0 30 + Hard Rock Coring Samples _ HOLE NO B 89-1

TOWN PRESS - EAST PROV.



GUILD DRILLING CO., INC. SHEET 1 of 2

100 WATER STREET EAST	PROVIDENCE R I	DATE
_	SS Cambridge, Mass.	HOLE NO
PROJECT NAME Sea Wall Improvements LOCATI	Revere, Mass.	LINE & STA.
D	IPROJ NO1025901	OFFSET
	1 1100:110:	SURF. ELEV. 18.4 NGV D

GROUND WATER OBSERVATIONS		CASING	SAMPLER	~~~		<u>Date</u>	Time
		CASING		CORE BAR	START	1/12/90	g.m
At after Hours	Туре	PW-HW	s/s		COMPLETE	1/30/90	a.m
Tidal	Size i D.	NW	1-3/8"		TOTAL HRS		p.m
At ofter Hours	Hommer Wt.	Spin_	140#	BIT	BORING FOR	EMAN N.	Stuttard
	Hammer Fall		<u> 30"</u>		SOILS ENGR	·	MUDIA

LOCATION OF BORING Blows per 6" Sample Type Casing Moisture SOIL IDENTIFICATION Strata SAMPLE on Sampler of Blows Depths Remarks include color gradation, Type of Density Change From soil etc. Rock-color, type, condition, hardper From - To Sample ness, Drilling time, seams and etc. 0-6 6-12 | 12-18 Consist Elev. Pen Rec Drill off Platform on Sea Wall 13' Boulders, Rip Rap (Fill) <u>17'</u> Note: Cobbles, Gravel and Concrete (Fill) 20' 20'-21.5' D Soft Gray Clayey Organic SILT, 18'18' trace of peat (OH) 22.3'-24.3' UP 24"24" JP1 Gray Organic CLAY (OH) 25.3'-25.8 (Vane Shear Test) V1 26.5'-28.5 UP 28' Gray Organic CLAY (OH) UP2 24'124'' Dark Brown PEAT (with Wood) 2 28.5'-30' 34 8 7 Stiff 18' Broke off 4" Casing 31.5' Change noted in drive resistence of casing at 31.5' 35'*-*37' 10 11 24 118 Very Brown Silty CLAY, trace 16 stiff of fine sand

GROUND SURFACE TO USED "CASING: THEN Sample Type Proportions Used 1401b Wt.x 30" fall on 2"0.D. Sampler SUMMARY: D=Dry C=Cored W=Washed Cohesionless Density | Cohesive Consistency Earth Boring 58.5 01010% trace 0-10 0-4 Soft 30 + Hard Rock Coring _ Loose UP = Undisturbed Piston little 10 10 20% 10-30 Med. Dense 4-8 M/Stiff TP=Test Pit A=Auger V=Vane Test Samples ___ 201035% some 30-50 Dense 50 + Very Dense 8-15 UT=Undisturbed Thinwall HOLE NO B89-2 35 to 50% | and 15-30 V-Stiff

TOWN PRESS - EAST PROV.

100 WATER STREET EAST PROVIDENCE, R 1.

P	ROJECT N EPORT SE AMPLES S	AME NT TO SENT TO					LOCATION PI	ROJ. NO. —— UR JOB NO. —	90-290		HOLE NO LINE & STA. OFFSET SURF. ELEV. Date			
		after	Нос	urs	Type Size I.D. Hamme Hamme	r Wt.	CASING	SAMPLE	CORE BAR	INSPECTOR .	S. EMAN			g.m
	LOCATIO	N OF BORING	:											
DEPTH	Casing Blows per foot	Sample Depths From- To	Type of Sample	Fron	llows per n Sample	er To	Moisture Density or Consist.	Strata Change	SOIL IDEN Remarks include soil etc. Rock-coness, Drilling tim	color, type, con-	dition . hard-		SAMP	PLE
	100	40'-41.5'	D	9	14	13	Very stiff	Elev.	Brown Silt	ty CLAY,				9"
		45'-46.5'	D	6	7	11	"		Gray Silt	y CLAY ((CL)	5	18'	18"
		47.5'-49.5' 49.5'-51'		10	7	9	.,			11				21"
								54.5'				6	18.	14''
		55'-56.5'	D	19	43	45	Very dense	58.5'	Gray silty SAND, trac (Refusal)	e gravel,		7	18"	10"
		58'-58.5'	D	110	/5" *2	2 0/1"		38.5		f Boring	58.5'	8	6''	0"
		(* denotes	300#	Wt.	on Si	poon)			(Bottom of Platform		om			
 - - -														

GROUND SURFACE TO _ USED __ "CASING: THEN Sample Type Proportions Used 140lb Wt.x 30" fall on 2"O.D. Sampler Cohesionless Density | Cohesive Consistency D=Dry C=Cored W= Washed trace 01010% Earth Boring 0-10 Loose UP = Undisturbed Piston 0-4 Soft 30 + Hard | Rock Coring _ little 10 to 20% IO-30 Med. Dense 4-8 M/Stiff TP=Test Pit A=Auger V=Vane Test Samples _ 20to35% some 30-50 Dense 50 + Very Dense 8-15 Stiff 15-30 V-Stiff UT=Undisturbed Thinwall 35 to 50% and

HOLE NO B89-2

SUMMARY:

TOWN PRESS - EAST PROV.



100 WATER STREET EAST		DATE
TO Haley & Aldrich, Inc. JADDRE	•	HOLE NO.B. 89-3
PROJECT NAME Sea Wall Improvements		LINE & STA.
REPORT SENT TO above/Revere Beach	UN TROUBLE	OFFSET
	OUR JOB NO. 90-290	SURF. ELEV. 13.4 NG V

GROUN	D WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		Date	Time
At 12.5 (4 dal)	after Hours	Type Size i.D. Hommer Wt	PW-HW 5"4" Drill	S/S 1-3/8" 140#	BIT	START COMPLETE TOTAL HRS BORING FOR	s	9 Texeira
LOCATION	OF BORING:	Hammer Fall		30"	511	INSPECTOR SOILS ENGR	W	. Rubik

At _		after	⊓00	rs	Hommer Hommer		<u> </u>	30"		INSPECTOR W.	Ru	bik	
	LOCATIO	N OF BORING											
ОЕРТН	Casing Blows per foot	Sample Depths From - To	Type of Sample	or From	ows per la Sample	er To	Moisture Density or Consist.	Strata Change Elev.	Remarks includ	TIFICATION le color, gradation, Type of olor, type, condition, hard- ne, seams and etc.	<u> </u>	SAMP	_
		0.5'-0.8	D D		0-4"	3	Very- Dense Medium	0.2'	Blacktop Gray coar Boulder Olive CLA	se SAND & (SW) (Fill) Y, some fine	1 2		2
		9'-11'	D	9 21	21	100/	Stiff " Hard		to medium fine Grav	Sand, tr. of el, tr. of Silt (Fill) (CL) nd, Silt, Clay Rubber (organic	3		17
		@14.0'	D	50	-0"		II II			on Boulder	4	0"	0
		19'-21'	D	6	4	5	Medium Stiff	17.5'		ILT and Shells	5	24	10
		22'-24'	UP V					25 51		nic CLAY (OH) hear Test)	Ul Vl	24	12
		26'-28'	UP D	8	9	11	Very-	25.5'	Gray Silt	y CLAY (CL) y CLAY, trace	U2 6	24	
		31'-33'	UP	15			Stiff		of fine s	L)	U3	24	
		33'-35'	D	19	12	13	Very- Stiff		'' (C	L)	7	2.4	<u>'5</u>
	CDOUNTS	39'-41'	D 10'	4	5		M.Stif		" (C		8	24	'2

THEN __ Sample Type 140lb Wt.x 30"fall on 2"0.D. Sampler Proportions Used D=Dry C=Cored W=Washed 01010% trace 0-10 Loose UP = Undisturbed Piston little 10 to 20% 10-30 Med. Dense TP=Test Pit A=Auger V=Vane Test 20to35% some

and

35 to 50%

Cohesionless Density | Cohesive Consistency 0-4 Soft 30 + Hard Rock Coring 4-8 M/Stiff 30-50 Dense 50 + Very Dense 8-15 Stiff 15-30 V-Stiff

Earth Boring 61 Samples _ HOLE NO B89-3

SUMMARY:

SHEET 1 OF

TOWN PRESS - EAST PROV. .

UT=Undisturbed Thinwall

G
TO
PROJECT NAME _
REPORT SENT TO
SAMPLES SENT T
GROUND W

	100 WATER STREET	EAST PROVIDENCE, R. I.	DATE
		IADDRESS ———————————————————————————————————	HOLE NO.B 89-3
ECT NAME		LOCATION	LINE & STA.
ORT SENT TO		PROJ. NO. 1025901	OFFSET
		90-200	1

SHEET_

SA	MPLES S	ENT TO						OUR JOB NO			SURF. ELEV.			
	GRO	OUND WATER OBS	SERVATIO	ONS			·				Date		ime	
٨٨				1			CASING	SAMPLER	CORE BAR.	START				_ a.
AT_		after	Hou	irs	Type					COMPLETE	:			_ g.
۸.		. 64.	11.		Size i.D.				-	TOTAL HR	rs. Reman			
At -		after	HOU	ırs	Hammei				- BIT	INSPECTOR				
					Hamme	r Fall			<u> </u>	SOILS ENG	R	===		
l	OCATIO	N OF BORING	:											
I	Casing	Sample	Type		lows per		Moisture	Strata		TIFICATION		T ,	SAMP	
DEPTH	Blows per	Depths	of	l	n Sample		Density	Change	Remarks include soil etc. Rock-d	de color, grad	lation, Type of		JAIVIF	LE
ä	foot	From - To	Sample	From 0-6	6-12	<u>Tc</u> i2-l8	or Consist.	Elev.	ness, Drilling tin	ne, seams an	id etc.	No.	Pen	Re
			1	<u> </u>	-							1	†	十
													†	T
		42'-44'	UP]		Gray Silty	CLAY	(CL)	U4	24	12
				12	1	1.0	4							
		44' 46'	· D	15	6	12	Very		Gray Silty			9	24	11
			+	13		 	Stif	[]	of fine sa	and (CL)	<u> </u>		
			 	İ	1							-	 	┼
														\vdash
		49'-51'	D	4	5	6	Stif	f	11	(CL)		IO	24	2
			 	5	ļ	 								
			+	 	 	 	-						-	<u> </u>
			+		ļ ———	 	1					-		-
		54'-56'	D	4	4	5	Stif	f	11	(CL)		II	24	122
				6						(01)				
				ļ	L	L								
			 	_	ļ									
		59'-61'	D	6	9 -	9	Very	_	**	(OT)		12	24	110
		33 -01	1 5	12		<u> </u>	Stif	f 61.0		(CL)		12	24	120
								01.0	Bottom o	f Borin	og 61 0'	+		-
									DOCCOM O	I DOLII.	19 01.0			
			-			ļ								
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-			 											
}			+											<u> </u>
	GROLIND	SURFACE TO _	1		L	USED _		CASING: 1	THEN			<u> </u>		
	mple Typ			1	Proportio)"fall on 2"0.D. S	amoler	i	SHAA	MAPY	-
_		red Willyashed			•	0.00		esionless Dens	sity I Cohesive C	onsistency	Forth	SUMM	I AN	·

TOWN PRESS - EAST PROV.

TP=Test Pit A=Auger V=Vone Test

little

some

and

10 to 20%

20to35%

35 to 50%

UP = Undisturbed Piston

UT=Undisturbed Thinwall

O-IO Loose IO-30 Med. Dense 30-50 Dense 50 + Very Dense 4-8 M/Stiff 8-15 Stiff 15-30 V-Stiff

0-4 Soft

30 + Hard Rock Coring Samples HOLE NO89-3



100 WATER STREET EAST	PROVIDENCE, R. I	B89-4
Haley & Aldrich, Inc. IADDRE	SS Cambridge, Mass.	HOLE NO
ROJECT NAME Sea Wall Improvements LOCAT	Revere, Mass.	LINE & STA.
EPORT SENT TO above/Revere Beach		OFFSET
AMPLES SENT TO	1	SURF. ELEV. 18.4. NEVO

SAMPLES SENT TO		OUR	JOB NO	<u>90-290</u>		SURF. ELEV. 18.4. NEVO			
GROUND WATER OBSERVATIONS At after Hours TIDAL At ofter Hours	Type Size D. Hommer Wt Hammer Fall	CASING PW-HW-NW 5" 4" 3" Spin		CORE BAR. NV-II BIT Dia.	START COMPLETE TOTAL HRS BORING FOR INSPECTOR SOILS ENGR	S. REMAN N. Stu Rub	Time q.m p.m g.m p.m lttard		
LOCATION OF BORING:									

					Hammer	-011		30"	Dia	SOILS ENGR.			
L	OCATIO	N OF BORING											
ОЕРТН	Casing Blows per foot	Sample Depths From- To	Type of Sample	on From	Sample	r Te	Moisture Density or Consist.	Strata Change Elev.	Remarks include soil etc. Rock-c	ITIFICATION te color, gradation, Type of color, type, condition, hard- ne, seams and etc.	No.	Pen	ī
								0.0'	Drilled of Seawall	Ef Platform on			
								14.2' 18' 19.5'	Boulders, Gravelly S	(Fill) Sands			
		22'-24'	UP	3	1	2	Soft		Gray-Brown fibrous PF Brown PEAT			24"	
		25'-25.5' 26'-28' 28'-30'	V UP D	1 4	2	2	Soft		Gravel (0)	ic CLAY with H) y Organic SILT,	V1 U2 2	24"	
		34'-36'	D	1 2	1	2	Soft	39'		ery, trace organic ed on spoon) (OL)	3	24'	0'
- 1		39'-40.5'	D	18	70	19*	Hard	1 	(pushed co	obble)	4	18'	101

GROUND SURFACE TO 14.5' core

USED NV-11 "CASING: THEN to 19.5' Spun Casing & Roller 1

Sample Type
D=Dry C=Cored W=Washed trace OtolO%
UP=Undisturbed Piston little 101e20%

O=Dry C=Cored W=Washed little 101e20%
USED NV-11 "CASING: THEN to 19.5' Spun Casing & Roller 1

Cohesionless Density | Cohesive Consistency | Earth Boring 7/6

Rock Coring (19.5) Spun Casing & Roller 1

SUMMARY:

Cohesionless Density | Cohesive Consistency | Cohesive Consistency | Cohesionless Density | Cohesionless Density | Cohesive Consistency | Cohesionless Density | Coh

UP= Undisturbed Piston
TP= Test Pit A=Auger V=Vane Test
UT= Undisturbed Thinwall

Iittle 10 to 20% O-10 Loose 10-30 Med. Dense 30-50 Dense 15-30 V-Stiff
UT= Undisturbed Thinwall

O-4 Soft 30 + Hard Rock Coring 5 Samples 11

A=8 M/Stiff 8-15 Stiff 15-30 V-Stiff
HOLE NO B89-4



100 WATER STREET

EAST PROVIDENCE, R I.

SHEET	Of
DATE	
HOLE NO.	B89-4

		HOLE NO. <u>B89-4</u>
0	ADDRESS ————	LINE & STA.
ROJECT NAME	LOCATION	
EPORT SENT TO	PROJ. NO	OFFSET
	00 200	f

SA	MPLES S	ENT TO						OUR JOB NO.	90-290		SURF. ELEV.			
	GRO	UND WATER OBSE	RVATIO	NS	-		CASIN	G SAMPLER	R CORE BAR.	START	<u>Date</u>	T	me	a.m
					Type Size I.D. Hammer Wt. Hammer Fall				- BIT	COMPLETE	S. REMAN	_		- p.m.
	OCATIO	N OF BORING												
ОЕРТН	Casing Blows per foot	Sample Depths From – To	Type of Sample	From	lows per 6 n Sample n 6-12	r Го	Moisture Density or Consist	Change		color, type, cor	ation, Type of ndition, hard- d etc.	No.	SAMP Pen	LE Rec
			<u> </u>		ļ		-		Gray Sil	ty CLAY	(CL)			L
		44'-46'	D	5	13	13	4		Gray Sil	ty CLAY,	trace		24'	18''
				18			Stiff	f	of fine	sand (C	L)		<u></u>	
]							
		49'-50.5'	D	7	5	12	- ",		'' (C	L)		6	18'	13'
		52'-54'	UP						'' (C	L)		<u>U3</u>	24'	24'
		54'-56'	D	10	9	8	,,					7	24"	18'
]							
		59'-60.5'	D	5.	6	4	Stifi	E	'' (CI	L)		8	18"	18'
							}							
		64'-65.5'	D	5	5	5	''		" (CI	.)		9	18"	18''
		67'-69'	UP						'' (CI	H)		Ŭ4	24"	24'
		69'-70.5'	D	4	12	11	Very Stiff	E	Gray CLA Lenses	Y, fine S (CL)	and	10	18'	18'
]							
		74'-75.5'	D	1 5	16	18	Hard	75.5'		ty CLAY (f Boring		11	18"	4"
						- · · · · · · · · · · · · · · · · · · ·								_

GROUND SURFACE TO _ USED _ "CASING: THEN 140lb Wt.x 30" fall on 2"0.D. Sampler Sample Type Proportions Used Cohesionless Density | D=Dry C=Cored W=Washed Cohesive Consistency 01010% trace 0-10 Loose 0-4 Soft 30 + Hard UP = Undisturbed Piston little 10 to 20% IO-30 Med. Dense 4-8 M/Stiff TP=Test Pit A=Auger V=Vane Test 20to35% some 30-50 Dense 50 + Very Dense 8-15 Stiff 15-30 V-Stiff

35 to 50%

and

Rock Coring Samples _ HOLE NO B89-4

Earth Boring __

SUMMARY:

UT=Undisturbed Thinwall



	3	GU						CO DVIDENCE	., [NC.		SHEET			
T.	Hale	ey & Aldr								•	HOLE NO			
PR	OJECT NA	ME Sea Wa	11 I	mpr	oveme	ents	LOCATION	Revere	, Mass.		LINE & STA.			
RE	PORT SEN	r to <u>abov</u>	<u>e/Re</u>	ver	e Bea	ch	IPR	OJ. NO	1025901		OFFSET			
SA	MPLES S	ENT TO						R JOB NO	90-290		SURF. ELEV.			VD_
	GRO	UND WATER OBSE	RVATIC	ONS			CASING	SAMPLER	CORE BAR.		<u>Date</u>		m e	
\†		<u>'</u> after 8		1	.		HW-NW	S/S		START	12/11/89 12/15/89	<u> </u>		g.m. p.m. g.m.
-					Type Size i D.		4" 3"	1-3/8	· · · · · · · · · · · · · · · · · · ·	I TOTAL HRS	3.			
\t _		_ after	Hou	irs	Hommer		Spin	140#	BIT	INSPECTOR	REMAN J.	Rul	<u>kei</u> oik	ra
					Hommer	Fall		30"		SOILS ENGR				
	OCATIO	N OF BORING:		T _		- 11						==	==	==
Ξ	Casing Blows	Sample Depths	Type		ows per 6 Sample		Moisture Density	Strata	SOIL IDEN Remarks includ	ITIFICATION de color arado	ation. Type of	s	AMPL	_E
DEPTH	per	From - To	Sample	From	\ <u> </u>	<u>To</u>	or	Change	soil etc. Rock-oness, Drilling tir	color, type, cor	ndition, hard-	No	Bos	Rec
_	foot	0.01.1.51	<u> </u>				Consist.	Elev.				+		
		0.2'-1.5'	D	31 4"	57	100-	Very- Dense		Blacktop Rock Fill		Fill,	1	16"	10
			<u> </u>	 -			Dense		ROCK TITE	(SM)				
		@ 4.0'	D	50-	D''		11 11		Cobbles a	nd Boulde	ers	2	0''	0''
			-	 	<u> </u>							-		
			<u> </u>					7.5'				1		
		01 111]		Gravelly	Sands				
		9'-11'	D	6	9	3	M.Dense /M.Stii					3_	24''	1''_
			 	-	 	<u> </u>	/H.SCII	1	Omeonie C	ת נ חדד	(OI)	 		
		12'-14'	D	2	1	1	Soft		Organic Si	ILI and P	eat (OL)	4	24"	11''
			ļ	2	ļ	ļ								
		15'-17'	She1	b T	, ho	-			No Po	covery		111	24''	0"
		13 -1/	pilel	by 1	пре				NO RE	COVELY		101	24	<u> </u>
		17'-19'	She1	ьу Т	ube				11			U2	24''	8''
		101 00 31	V	<u> </u>	<u> </u>	 	-		(Vana Chan	. m \		V1		
		19'-20.3'	V		<u> </u>				(Vane Shear			VI		-
		21'-23'	D	4	5	3	Medium		Gray O r ga of fine s		, trace	5	24''	16"
		201 0/ 51	ļ	1_	ļ		Stiff		(Vane Shear	• •		770		L
		23'-24.5'	V		ļ	-	1		(valle bliea)	i lest)		V2	\vdash	
		25'-27'	She1	ру Т	ıbe		1		No Re	covery		บ3	24''	0"
													2.11	2011
		27'-29'	D	MOK	1=12	1	Soft		Gray Orga			6	24"	20"
			 	†			1		or rine s	and (OL	,		-	-
		30'-30.5'	V]		(Vane She	ar Test)	· V3		
				ļ	ļ		1							
					-		1	33.5'				<u> </u>	-	-
		34'-36'	D	2	4	4	Medium		Gray Silty	-		7	24"	22"
				6			Stiff .	35.9'	fine sand	ın seams	(CL)	-		
			 	ļ	 		1				•	-	<u> </u>	<u> </u>
				 	 	 	1		Brown coar			-		-
		39'-41'	D	10	21	5/32	Dense		trace of f		e1 (SW)	8	24"	611
		SURFACE TO	5 9'			USED _		CASING:	THEN S/S t					
	omple Typ				Proporti			40lb Wt.x3	O"fall on 2"O.D. sity Cohesive	Sampler Consistency	Fort	SUMN Borin	MARY	51'
		ored W=Washed bed Piston			troce little	0 to 10°0	′	-10 Loo			•	Corin	, —	

TP=Test Pit A=Auger V=Vane Test UT=Undisturbed Thinwall

some 201035% 35 to 50% and

10-30 Med. Dense 30-50 Dense 50 + Very Dense

4-8 M/Stiff 8-15 Stiff 15-30 V-Stiff

Samples . HOLE NO.B89-5

	3	GL						CO.	., INC.		SHEET DATE HOLE NO.
PF							LOCATION		90-290		LINE & ST OFFSET _ SURF. ELE
	GRO	5	Type Size i D. Hammer Hammer		CASING	SAMPLER	CORE BAR	START COMPLETE TOTAL HRS BORING FOR INSPECTOR SOILS ENGR	S. REMAN		
ОЕРТН	Casing Blows per	N OF BORING Sample Depths From - To	Type of Sample	on	ows per 6	r	Moisture Density or Consist.	Strata Change Elev.	SOIL IDEN Remarks includes soil etc. Rock-oness, Drilling tin	NTIFICATION de color, grado color, type, con	ation, Type
	foot	44'-46'	D	13	24		Dense	Liev	Brown coato medium	arse SAND	, fine
		49'-51'	D	12 26	14	19	11	49'	Brown sil SAND, lit cobbles a	tle grave	l with
		54'-56'	D	12 36	12	28	11		"		
		59'-61'	D	9 15	12	17	Medium Dense	58.8'	Brown coar	rse grave	1 (SW)
									Bottom of	t Boring	51.0'

2

B89-5

Time

SAMPLE

9 24 8"

10 24"

11 24

12 24"9

HOLE NO B89-5

Pen Rec

_ OF .

GROUND SURFACE TO USED "CASING: THEN 140 lb Wt.x 30" fall on 2"0.D. Sampler Cohesionless Density | Cohesive Consistency Sample Type Proportions Used SUMMARY: Earth Boring _ D=Dry C=Cored W=Washed 01010% trace Soft 0-10 Loose 0-4 30 + Hard Rock Coring _ UP = Undisturbed Piston little 10 to 20% 4-8 M/Stiff 8-15 Stiff 15-30 V-Stiff 10-30 Med. Dense Samples _

30-50 Dense 50 + Very Dense

UT=Undisturbed Thinwall

TP=Test Pit A=Auger V=Vane Test

some

and

20to35%

35 to 50%

APPENDIX B

Logs of Test Pits, Plans and Sections

					, 		
		Haley &	Aldrich,	inc. TEST PIT REPORT	TEST PIT	NO. <u>89-1</u>	
-					FILE NO	10259-01	
- 1	OJECT				LOCATION	See Plan	
LO	CATION _			SSACHUSETTS			
CLI	ENT	UNITE		TES ARMY CORPS OF ENGINEERS	ELEVATION	-0.60 NGVD	
COI	NTRACTO	R USED	J. N	MARCHESE & SONS	EXPLORATIO	ON DATE 4 JAN 90	
EQI	UIPMENT	USED _	MITS	SUBISHI MS 230 LC EXCAVATOR	H&A REP_	PELNIK/RUBIK	
SCAL IN FEE	STRATA CHANGE	SAMPLE NUMBEF	SAMPLE DEPTH RANGE	DESCRIPTION OF MATERIALS		REMARKS	
- 2	0.4	S1 S1A	0-2.5	Gray mostly fine SAND, little coars to fine, subrounded to subangular gravel, subrounded cobbles, 3 to 8 diameter, subangular bounders, 18-i diameter, SP	pit a	entering test at 2- ft. depth, ing from west.	
_ 4-	3.0	S2 S2A	2.5-5	Gray to black, mostly coarse to fir subrounded to subangular Gravel, sor coarse to fine sand, little subround cobbles, 3 to 8 in. diameter, with 8 to 18-in. diameter boulders, trace organic silt, GW. Gray, mostly organic SILT, some class	ne ded Noted petro black	organic or leum odor in layer from 2 ft. depth.	
_ 6-		S3 S3A	5-7.5	trace shells and brown peat fibers, OL. No dilatance, low plasticity and toughness. Organic odor Occasional layers of silty fine sand	Su vand to 0. torva	ried from 0.2 5 kg/cm² by ne. alls stable in ive soils.	
- 8 -		S4 S4A	7.5 - 10	Gray to brown silty CLAY, CL/ML. Mostly clay, some silt, trace brown peat fibers, no dilatancy, medium plasticity and toughness.			
_ 10_				Occasionally stratified with layers of fine SAND, 1/16 to 1/2 in. thick.			
_		-		Bottom of Exploration at 10.0 ft. depth. All samples were moist. Tes pit excavated during low tide cycle, 0910 to 0930.	t manua	's 1-5. Visual/ 1 descriptions STM D2488.	
	WATER	LEVEL		APPROXIMATE PIT DIMENSIONS AT SURFACE	1	SUMMARY	
D,		TIME*	DEPTH (feet)	LENGTH 12 FEET WIDTH 4 FEET	DEPTH	10.0 ft.	
4 JA		0	2.0	BOULDERS - SURFACE RIP			
		(lt	idal)	8° TO 18° DIAMETER = VOLUME		MPLES	
*AF1	TER COM			OVER 18° DIAMETER (number) = VOLUME (cu ft)	- WATER I	EVEL 2.0 ft.	

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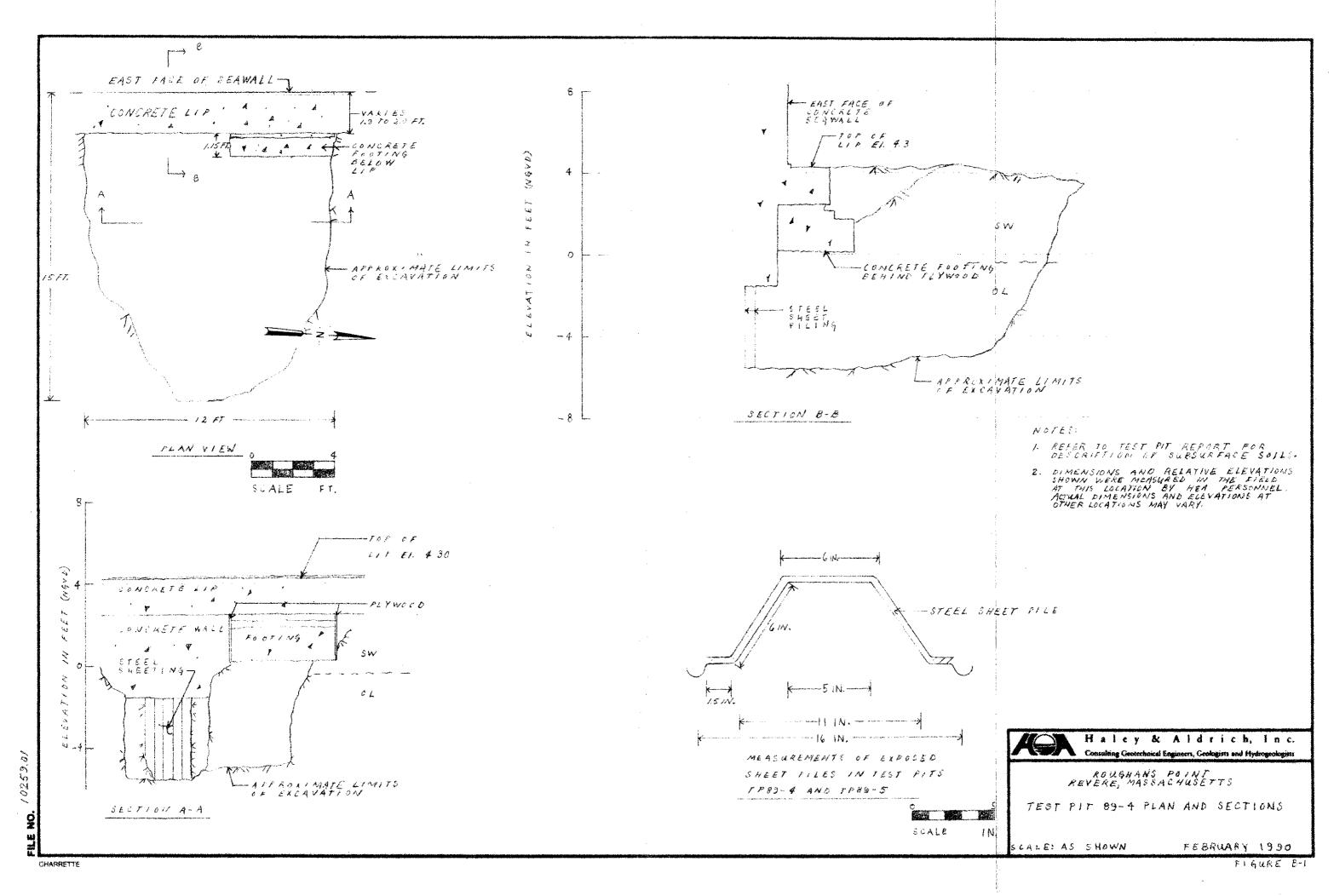
i								
A		Haley &	Aldrich,	Inc. TEST PIT REPORT	TEST PIT NO. <u>89-2</u> FILE NO. <u>10259-01</u>			
PRO	DJECT _	ROUGI	IANS PO	DINT	LOCATION See Plan			
LOC	CATION _	REVE	RE, MAS	SACHUSETTS	LOCATION			
CLI	ENT	UNITE	ED STAT	ES ARMY CORPS OF ENGINEERS	ELEVATION _ 1.91 NGVD			
CON	ITRACTO	R USED	J. N	IARCHESE & SONS	EXPLORATION DATE 4 JAN 90			
EQL	IIPMENT	USED	MITS	UBISHI MS 230 LC EXCAVATOR	H&A REP PELNIK/RUBIK			
SCALE	STRATA	CAMPLE	SAMPLE		TIGA (IEF			
IN FEET		NUMBER	DEPTH RANGE	DESCRIPTION OF MATERIALS	REMARKS			
- 2 - - 4-	4.4	\$1 \$1A \$2 \$2A \$3 \$3A	0-2 4-5 5-7.5	Brown to gray, mostly coarse to fin subrounded GRAVEL, some coarse to f sand, little subrounded cobbles, 3 8-in. diameter, few subrounded boulders, 8 to 18-in. diameter, trace shell fragments, GW. Gray, mostly fine SAND, some silt, little coarse to fine, subrounded gravel, few subrounded cobbles, 3 to 8-in. diameter, trace shell fragment SM. Brown fibrous PEAT, trace organic silt, fine sand, pt. Organic odor. Noted 1/2 to 2 in. layers of gray silty fine sand interbedded with peadeposit from 6.4 to 7.5 ft. depths.	e at 1.5-ft. depth. ce Pit walls stable in cohesive soils.			
- 8 -	9.0	S4 S4A	7.5-9	Gray silty clay, CL/ML. Mostly clay some silt, no dilatancy, medium plasticity and toughness. Bottom of exploration at 11.0 ft. depth. All samples were moist. Tes Pit excavated from 1035 to 1100 duri low tide cycle.	Photo's 6-14. Visual/Manual Descriptions per ASTM D 2488			
	WATER			APPROXIMATE PIT DIMENSIONS AT SURFACE	SUMMARY			
DA		TIME* (hours)	DEPTH (feet)	LENGTH 18 FEET WIDTH 8 FEET	DEPTH11.0 ft.			
4 JA		0	1.5	BOULDERS	JAR SAMPLES4			
		(t	idal)	8' TO 18' DIAMETER4 = VOLUME3	BAG SAMPLES1			
*AFT	ER COM	PLETED		OVER 18" DIAMETER = VOLUME (cu ft)	- WATER LEVEL 1.5 ft.			

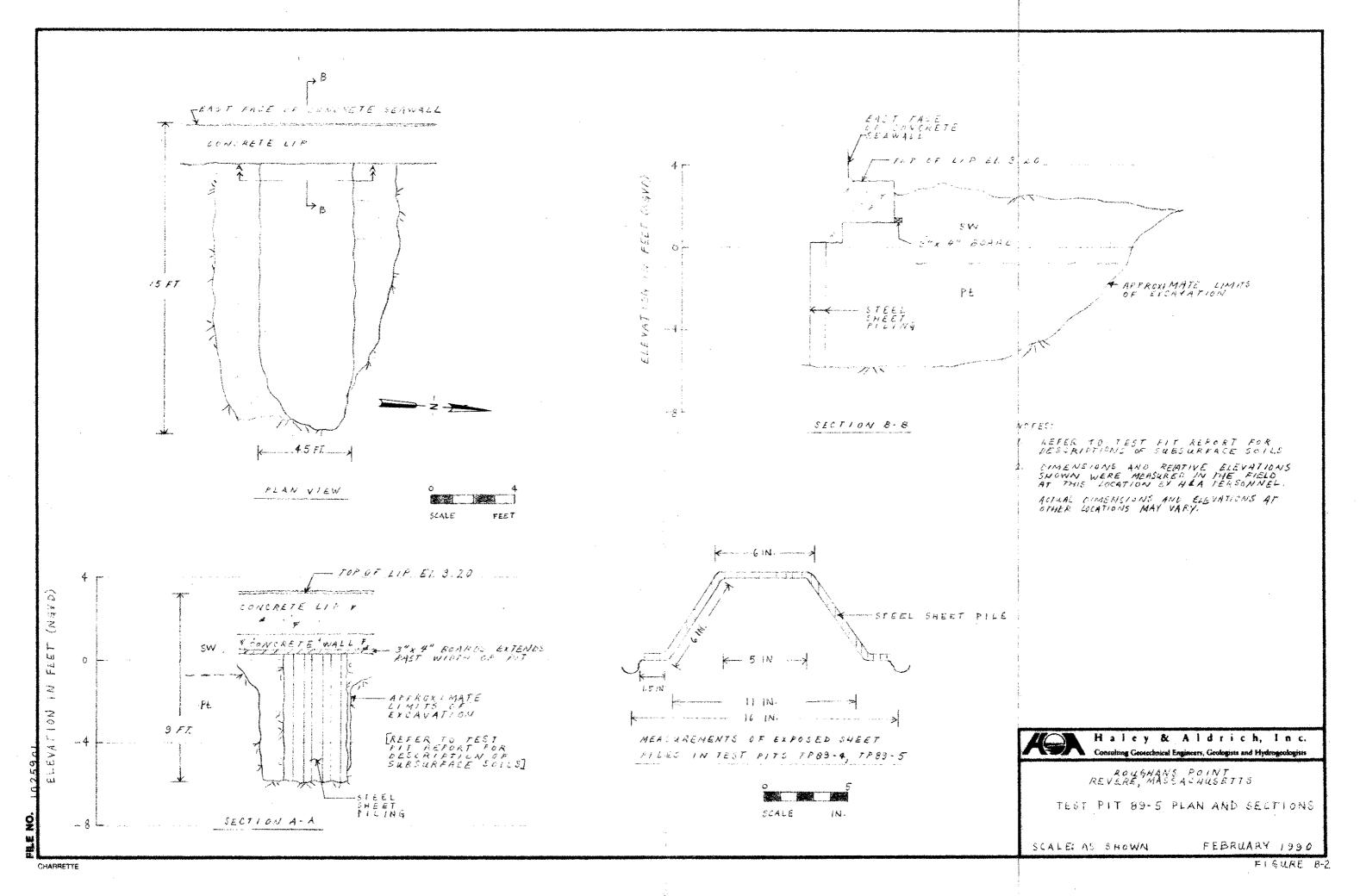
Form 24 Rev. Mar. 88

ſ		. "	-			_				
1	4		Haley & /	Aldrich, I	nc. TEST PIT REPORT	I	TEST PIT NO. 89-3			
L						FILE	NO. 10259-01			
١	PRO	JECT	ROUGH	ANS PO	INT	LOC	ATION <u>See Plan</u>			
l	LOC	ATION _	REVER	E, MAS	SACHUSETTS	l				
ı	CLIE	NT	UNITE	D STAT	ES ARMY CORPS OF ENGINEERS	ELE	VATION1.04 NGVD			
l	CON	TRACTO	R USED.	J. M.	ARCHESE & SONS	EXP	EXPLORATION DATE 4 JAN 90			
ĺ	EQU	IPMENT	USED	MITS	UBISHI MS 230 LC EXCAVATOR	H& A	A REPPELNIK/RUBIK			
6	CALE	STRATA	SAMPLE	SAMPLE		T				
ŀ	IN FEET	CHANGE	NUMBER	DEPTH RANGE	DESCRIPTION OF MATERIALS		REMARKS			
			S1	0-2.5	Gray, mostly coarse to fine SAND,					
			SlA		some coarse to fine, subrounded					
					gravel, little shell fragments, SW.	•				
	- 2-	2 .								
2 2 s2 2.5-					, , , , , , , , , , , , , , , , , , , ,	o,				
S2A					some coarse to fine, subrounded gravel, little subrounded cobbles,	2				
					to 8-in. diameter, little shell	,				
					fragments, SW.		Water entering test			
	- ⁴ - ^{4 · 2}				¬ Brown fibrous PEAT, Pt. Layer		pit above organic soils on east end			
			20		ackslash thins and disappears toward southwe	est.	of pit.			
			S3 S3A	5 - 7.5	Unable to obtain sample					
	_				Brown mostly coarse to fine subroun	nded				
_	- 6_				GRAVEL, some coarse sand, little cobbles, subrounded, 3 to 8-in.					
					diameter, little shell fragments, G	W.				
-	- 8-				Bottom of exploration at 7.5 ft.					
					depth, due to collapsing sides of test pit.					
					cest pit.					
					All samples were moist. Test Pit w	as				
_	.10_				excavated from 1115 to 1145 during low tide cycle.					
							Photos 15-22.			
							Visual/Manual			
							descriptions per ASTM D 2488.			
			-							
WATER LEVEL					APPROXIMATE PIT DIMENSIONS AT SURFACE	\dashv	SUMMARY			
	DATE TIME* DEPTH				LENGTH 22 FEET WIDTH 11 FEET					
L	(hours) (feet) 4 JAN 90 0 4.3				BOULDERS	JAR SAMPLES3				
_	4 JAN 90 0 4.3 (tidal)				8" TO 18" DIAMETER					
					OVER 18° DIAMETER = VOLUME	WATER LEVEL 4.3 ft.				
	*AFTER COMPLETED				(number) (cu f	t)	WATER LEVEL			

					_	
A		Haley &	Aldrich,	Inc. TEST PIT REPORT	i .	ST PIT NO. <u>89-4</u> E NO. <u>10259-01</u>
PRO	JECT	ROUGH	IANS PO	INT	<u> </u>	CATION See Plan
ł				SACHUSETTS	100	CATION
i				ES ARMY CORPS OF ENGINEERS	[EVATION _4.30 NGVD*
				ARCHESE & SONS		PLORATION DATE 5 JAN 90
		USED _		UBISHI MS 230 LC EXCAVATOR	ı	A REP PELNIK
					H&.	A REP TELNIK
IN FEET	STRATA CHANGE	SAMPLE NUMBER	SAMPLE DEPTH RANGE	DESCRIPTION OF MATERIALS		REMARKS
- 2-		S1	0-2	Brown mostly coarse to fine SAND, so coarse to fine, subrounded gravel, little subrounded cobbles 3 to 8-indiameter, trace silt, shell fragment SW. Surficial riprap boulders, subangular, 18 to 36-in. diameter, previously moved for pit access. Replaced 1-6-90.	n. nts,	lip on seawall. Top of seawall El. 17.70.
- 4 <i>-</i>	4.7			Layer turns black, organic or petro leum odor from 4 to 4.7 ft. depth.	- ,-	Pit walls stable in
6				Clayey organic silt, OL. Gray, mostly organic silt, some clay, tra peat fibers, occasional 1/16 to 1/2 in. layers of fine sand.		See attached sketches of seawall.
8 _				Increasing content of peat below 6. ft. depths, to peaty organic silt. Organic odor.	0-	USACE representatives on-site to observe test pit.
-10-				Bottom of exploration at 9.8 ft. Test pit excavated from 1000 to 121 during low tide cycle. Backfilled pit in ±2-ft. lifts, tamped with	0	Photos 1-15 Visual/Manual descriptions per ASTM D 2488
		-		bucket of excavator. Pushed organisoils back against piling.	С	
D	WATEF	TIME*	DEBTU	APPROXIMATE PIT DIMENSIONS AT SURFACE		SUMMARY
		(hours)	DEPTH (feet)	LENGTH 15 FEET WIDTH 12 FEET		DEPTH9.8 ft.
5 JA	N 90	0		BOULDERS - SURFICIAL RIPE	RAP	JAR SAMPLES
LOW	TIDE	1120		8" TO 18" DIAMETER = VOLUME	_]	BAG SAMPLES
*AFT	ER CO	MPLETED)	OVER 18° DIAMETER (number) = VOLUME (cu fi	t)	WATER LEVEL

A		Haley &	Aldrich,	inc. TEST PIT REPORT	1	ST PIT NO89-5
-		POHON	LANG DO	TAIR	↓	E NO10259-01
	OJECT CATION _		IANS PO	SACHUSETTS	LO	CATION See Plan
						2 22 2222
	ENT			ES ARMY CORPS OF ENGINEERS	l	EVATION 3.20 NGVD*
				ARCHESE & SONS	1	PLORATION DATE 6 JAN 90
<u> </u>	JIPMENT			UBISHI MS 230 LC EXCAVATOR	Н&	A REP PELNIK
BCAL IN FEE1	STRATA CHANGE	SAMPLE NUMBEF	SAMPLE DEPTH RANGE	DESCRIPTION OF MATERIALS		REMARKS
– 2 -		S1	0-3	Brown mostly coarse to fine SAND, some coarse to fine, subrounded gravel, little subrounded cobbles, to 8-in. diameter, trace silt, shel fragments, SW. Surficial riprap, boulders, subangu	.1	*Elevation at top of lip on seawall. Top of seawall El. 17.47, depths are from top of lip.
				18 to 36-in. diameter, previously moved for pit access. Replaced 1-6		
_ 4-	4			Layer turns black, with organic or petroleum odor from 3 to 4 ft.		Minor water seepage from sand layer above organic soils.
				Brown clayey PEAT with organic silt Pt.	,	
_ 6_				Mostly fibrous PEAT, some clay, little organic silt, no dilatancy, medium plasticity and toughness. Organic odor.		Pit walls stable in organic soils.
o						See attached sketches of seawall.
_ 8 _				Bottom of exploration at 9.0-ft.		
- 10 -				depth. Test pit excavated during low tide cycle. Backfilled pit in ±2-ft. lifts, tamped with bucket of excavator. Pushed organic soils back against piling.	_	Photos 16-22 Visual/Manual discriptions per ASTM D 2488
		,				
		LEVEL	DEST	APPROXIMATE PIT DIMENSIONS AT SURFACE		SUMMARY
	DATE	TIME* (hours)	DEPTH (feet)	LENGTH 15 FEET WIDTH 4.5 FEET		DEPTH 9.0 ft.
6 J	AN 90	0		BOULDERS -SURFICIAL RIPRA	Р	JAR SAMPLES
OW '	TIDE	1230		8° TO 18° DIAMETER = VOLUME		BAG SAMPLES1
AF	TER COM	MPLETEC)	OVER 18 DIAMETER (number) = VOLUME (cu f	t)	WATER LEVEL





APPENDIX C

Plotted Results of Laboratory Oedometer, Triaxial and Gradation Tests

- for laboratory test programs involving tube samples, partiment gestechnical laboratory data relating to soil descriptions and index and engineering parameters of the material, are presented in the Summary of Geotechnical Laboratory Test Products table(s) preceding these Notes. These data are plotted versus eleverion (or dopth) on the figure entitled "Geotechnical Laboratory Classification, Index and Engineering Parameters vs. Elevation (or Depth)." Rofer to the various Appendices, identified in the Geotechnical Laboratory Test Program section of this report, for additional laboratory data in graphic form and more detailed test-specific tabulated data and test procedures such as the following:
- grain size distribution curves;
- compaction test moisture vs. dry density curves; consolidation test tog stress vs. strain curves and plots of time-rate of consolidation parameters;
- strongth test Shear stress vs. strain curves and effective stress paths; and tabulated data for the individual consolidation, strength and permeability tests
- Soil descriptions are based on the U.S. Army Corps of Engineers and Bureau of Reciamation Unified Soil Classification System (USCS) (Bureau of Reclamation, 1986) with some modifications. Soils are described as follows: consistency or relative density, color, adjective for secondary component (when appropriate), major component (in upper case), additional components with appropriate descriptors (i.e., "little" or "trace"). Each portion of the sample description is arrived
 - The scale used to qualitatively describe the <u>consistency</u> of cohesive soils (after Terzaghi and Peck, 1967), is based on Torvane index shear strength measurements and is as follows:

INDEX SHEAR STRENGTH (TV; tsf) CONSISTENCY less than 0.13 0.13 to 0.25 0.25 to 0.50 Medium stiff Stiff 0.50 to 1.0 Very stiff greater than 2.0

Should sand or other cohesionless soils be encountered, <u>relative density</u> is described on the basis of Standard Penetration Test (SPT) resistance, N, in blows per foot (ASTM D 1586), (after Terzaghi and Peck, 1967) as follows:

SPT N (blows per foot)
0 to 4
4 to 10 RELATIVE DENSITY Medium 10 to 30 greater than 50

Color is described using basic colors such as brown, yellow, black, red, red-brown, gray, blue-gray, etc.

• Сопрог	ment definitions by gradations are as follows	:		
MATERIAL Cobbles	DEFENITIONS Material passing through an 8-in. square	FRACTIONS		NDARD SIEVE RETHD. ON
	opening and retained on a 3-in. sieve.			3·in.
Gravel	Material passing the 3-in, sieve and	Coarse	3-in.	3/4-in.
	retained upon the No.4 sieve.	Fine	3/4·in.	No.4
Sand	Material passing the No.4 sieve and	Coarse	No.4	No. 10
	retained upon the No.200 sieve.	Medium Fine	No.10	No.40
		rine	No.40	No.200
Silt	Material passing the No.200 sieve, classif		No.200	
	the basis of its Atterberg Limits; on the Chart, silts plot below the A-line. Typic	Plasticity ally, silts		
	exhibit relatively low to no plasticity, l	ow dry		
	strengths, and quick response to dilatancy	checks.		
Ctay	Material passing the No.200 sieve, classif	ied on	No.200	-
	the basis of its Atterberg Limits; on the	Plasticity		
	Chart, clays plot above the A-Line. Typic exhibit some to significant plasticity, me-	ally, clays		
	dry strength and slow to no response to di	latancy chec	ks.	
Organic	Organic Silt and Organic Clay are identifi	ed on	No.200	
Soils	the basis of their Atterberg Limits and th	e effect		

of oven-drying on the liquid limit. Visual aspects such as dark brown, gray or black color, a medium to pungent odor and soft consistency are indicators organic nature. Organic clay plots above the A-Line and organic silt plots below this line on the

Highly organic soils such as Peat are identified by a combination of the following: <u>visual aspects</u> such as dark brown, dark gray or black color and/or the appearance of roots or fibers; <u>medium to pumgent odor</u>, such as hydrogen sulfide, attributable to decaying organic matter; <u>Atterberg limiter</u> and organic matter of the property of the propert Limits; and organic matter content.

Material is classified as coarse-grained (SAND or GRAVEL) or fine-grained (CLAY or SILT) on the basis of the percentage of material finer than the U.S.Standard No.200 sieve, in accordance with USCS.

If more than half the sample (by weight) is coarser than the No.200 sieve if more than next the sample (by weight) is coarse; then the nation of GRAVEL, (0.974mm), then the major component is coarse-grained (either SANO or GRAVEL, whichever is present in the Largest percentage, by weight). This coarse-grained component is further described by the predominant fractions (coarse, medium and/or fine) which are present.

If more than half the sample is finer than the No.200 sieve, then the major component is fine-grained (either CLAY or SILT, depending upon the Atterberg Limits of the sample and their location with respect to the A-Line on the plasticity chart.)

- The major component is preceded by the secondary component in the form of a descriptor, such as sandy, clayey or gravelly, if this secondary component is present in excess of 20 percent by weight.
- ADDITIONAL COMPONENTS:
 Other components of the soil are included in the sample description preceded by the following descriptors on the basis of the percentages at which they occur:

PERCENTAGE (by wt.)
greater than 20
11 to 20

DESCRIPTOR

3. Terminology related to stratified or heterogeneous soils is applied as follows:

STRATIFICATION	THICKNESS OF STRATA
Lamina	0 to 1/16 in. (cohesive soil)
Parting	0 to 1/16 in, (conesiontess soit)
Seam	1/16 to 1/2 in.
Layer	1/2 to 12 in.
Stratum	Usually greater than 12 in.
OTHER TRREGULARITIES	DEFINITION
Pocket	Small erratic deposit usually less than 1/2-in. thick, not laterally extensive. Identified in

conjunction with other test boring data. Lenticular deposit, larger than pocket, also not laterally extensive. Identified in conjunction with

PRECUENCY Occasional OFFINITION
One or less stratification per foot of thickness. frequent More than one stratification per foot of thickness,

other test boring data.

Very frequent More than one stratification per inch of thickness.

Interbedded Applied to strata of soil (vine between or

- 4. Unless otherwise noted in the Boring No. and Sample No. column of the Summary of Geotechnical Laoboratory Test Results toble, the laboratory test specim obtained from 3.0 in. outside diameter thin walled tube samples. Refer to the Field Exploration section of the report for the specific sampling method employed (usually in accordance with ASTM D 1587). Prior to extrusion, the tube samples are stored in a room maintained at between 90 and 100 percent relative humidity. Specimens are extruded from short sections of the tube sample to help minimize the shear disturbance due to extrusion. Consolidation, strength and permeability test specimens are trimmed in the humid room.
- Grain size distributions are measured in general conformance with ASTM D 421 and 0 422. Suggestions from Lambe (1951) are incorporated in the techniques for sample handling. The distribution of grain sizes retained upon the No.200 sieve is evaluated using various sieves including those listed above, while the distribution of fine-grained material is evaluated using the hydrometer method. It is important to remember that sampling soils according to the split-spoon method (ASTM D 1586) using the split-barrel with a 2.0-in. outside diemeter, only allows for sampling of soil particles which can pass through a cylindrical opening which is 1.375 in. in diameter. Thus, cobble and coarse gravel components of the soil are selectively removed from the sample prior to testing.
- Natural water contents, www, are measured in accordance with ASTM D 2216, except that soils containing organic materials are oven-dried at 650. Typically, natural H water contents are actually the water contents of the material
- 7. Atterberg Limits are performed in conformance with ASIM D 4318. Clays and organic materials are never air dried prior to evaluating the limits due to the potential for nonunique rehydration. Liquid limits are determined using the multipoint method on soil beginning at about the natural water content using a flat grooving tool and a cup device with a hard-rubber base.
- 8. Loss on Ignition is determined by measuring the loss in weight of a 5 to 10g-sample of oven-dried (7=65C) -No.40 material caused by heating the material in a small porcelain crucible with a propane torch until the color of the soil is homogeneous or until no additional weight is lost. Weights are measured to the nearest 0.0001g.
- Total unit weights, 0, measured in accordance with ASTM D 2397 and presented in parentheses, e.g., (120.2), indicate an average for the entire thin-walled tube sample (the first value listed for a given tube sample) and for the individual short tube sections for the values listed at increasing depths. Other unit weights are obtained from individual consolidation, strength and permeability test samples, where available, and are based on the weights and volumes of those samples.
- Compaction characteristics are determined in general accordance with either ASTM D 1557 or D 698; the specific procedure used is indicated on the individual compaction curves. Typically, ASTM D 1557 Method C is employed, regardless of the percentage of coarse gravel in the sample. Corrections for the +3/4-in. fractio
- 11. The index strength tests, Torvane, IV; Pocket Penetrometer, PP; and Shear Vane, SV; are performed in the sample tube during the sample extrusion process. When the soil to be tested has been pushed with a hydraulic jack such that it is flush with the cutting template surface, the index strength tests are performed in the order listed above. All strengths are reported in tons per square foot (fsf). The test values reported for IV and PP tests typically represent the average of three measurements made with each device on each exposed surface. The pr value is divided by two since the value obtained from the instrument is interpreted as a measure of the compressive strength of the material. The SV test is performed only once on each surface. After measurement of the "undisturbed" shear strength with the SV, the vame is rotated 360 degrees in the soil sample. This rotation is immediately followed by measurement of the "remoided", R. strength.

12. Consolidation Tests are one-dimensional, incrementally-loaded Dedometer Tests. conformed in general conformance with ASTM 0-2435. Typically, the load incrementatio, LLR, (= $\Delta T_{c}/T_{c}$) is approximately equal to 0.7 for stresses greater than 0.8 tsf, except on reloading cycles, where LIR is equal to one

Preconsolidation pressure, C'e, is determined via the Casagrande construction on the strain vs. log vertical strass curves from these tests, considering vertical strain at the end of primary consolidation. Time to primary, called to or End of Frimary, EOP, is estimated using the Casagrande construction on displacement vs. log elassed time, plotted for each increment. End of Increment, EOI, strains are plotted on the log stress vs. strain curve for load increments immediately followed

The recompression ratio, RR, is determined from an unload-reload cycle performed ine recompression ratio, as, is determined from an uncoderations of the periodic affect at least two to three percent strain has been incurred by the sample.

Unloading is carried out to an overconsolidation ratio, OCR, equal to 8. The compression ratio, CR, is evaluated as the slope of the steepest portion of the log vertical stress vs. strain curve during virgin compression.

test quality is based on engineering judgement following review of the log stress curve vs. strain curve and other consolidation data such as coefficient of consolidation and coefficient of secondary compression vs. the log of the stress ratio, (= G' / J'_p). The qualitative scale is as follows: "E" (excellent), "YG" (very good), "G" (good), "F" (fair), "P" (poor).

13. The shear strength of fine-grained soils is typically evaluated on the basis triaxial tests. The types of tests performed, in order of increasing degree of sophistication, are as follows:
UU Unconsolidated Undrained Triaxial Compression

Isotropically Consolidated Undrained Triaxial Compression Kg Consolidated Undrained Triaxial Compression

The <u>UU triaxist test</u> is performed in general conformance with ASTM D 2850. Several modifications, including the measurement of pore pressure and other variations described below, are incorporated in the test procedure to enable better interpretation of the test results. The samples are tested at the "mas-sampled" (or "as-received") water content and hence, the reliability of the measured pore pressures is related to the initial "as-sampled" degree of saturation. The s are allowed to equilibrate for several hours at the desired test cell pressure so that an estimate of the initial effective stress can be obtained. 8 values $(\pm \Delta u/\Delta \mathcal{T}_c)$ are checked prior to shear.

Since pore pressure, u, is measured at the base of the sample, the strain rate at which the sample is sheared should be slow enough to allow for some equilibration of u throughout the sample. Typically, silty CLAY and SILT samples are sheared bt an axial strain rate equal to approximately 4 percent per hour, which is about tentimes faster than is typical for a consolidated undrained triaxial test. Thus, the tests can be performed in a reasonable amount of time and there is some increase in strain rate to counteract the effects of disturbance, while there is some time

Shear stress, q, is calculated taking into account the resistance of the membrane and the changing area of the sample. The exial strain at failure, \mathcal{E}_f or \mathcal{E}_p , is that at peak shear stress, c_u , which is usually considered the undrained shear strength of the soil

The CIUC triaxial test is performed in general accordance with the sample handling and preparation techniques suggested by ASTM D 2850. The procedures flowed for performance of the backpressuring, consolidation and shearing portions of the test are obtained from Bishop and Menket (1957). Details regarding backpressure levels, consolidation history and shear data, including stress vs. strain curves, effective stress paths, pore pressure parameters and Young's modulus, are contained in the Appendix identified in the geotechnical laboratory test program section of this

14. Constant Head Permeability tests are performed in general conformance with the Lons tark near remeability tests are performed in general conformance with the U.S.Army Corps of Engineers procedure designated EM 1102-2-1906 (dated 30 Novemb 1970). All "undisturbed" samples and laboratory-prepared samples which are estimated to have permeabilities less than approximately 1 x 10⁻⁴ cm/sec are tested using flexible wall equipment.

E9E40: American Society of Testing Materials. Enquid Limit, Plastic Limit and Plasticity Index, respectively. tops on ignition, typically used as a relative measure of the organic content of the material. $\label{eq:content} % \begin{array}{ll} & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ \end{array}$ F01 Total Unit Weight and Dry Unit Weight, respectively. Sella Compaction characteristics: Max. Dry Unit Weight and Optimum

and Pocket Penetrometer tests, repectively, using hand-held devices marketed by Soiltest, Inc.

Water Content, respectively.

Shear Vane test using the hand-held Lab Vane device marketed by Geomor. (R) refers to the vane test result on remoided soil.

CED

John x Hopt

Effective Vertical Stress and Preconsolidation Pressure, J'm J'v

OCR Overconsolidation Ratio, (= 5 '~/ 5'v).

pressure measurements.

Compression and Recompression Ratios (= A & / A log T',) during

Coefficient of Consolidation, evaluated on the basis of displacement vs. log elapsed time (= 0.1978d 2/tsg)

Coefficient of Secondary Compression (=46/4logt), evaluated sometime after time to primary has been achieved.

Isotropically Consolidated Undrained Triaxial Compression test.

Unconsolidated Undrained Triaxial Compression test with pore

Anisotropically (Kg) Consolidated Undrained Triaxial Compression

Shear Stress (=(0 1. 03)/2)

Average Effective Stress (*(đ '1* 5 '2)/2)

Direct Simple Shear Test.

Undrained Shear Strength, typically peak value.

Axial Strain at peak shear stress and/or failure.

Coefficient of Permeability.

055

American Society of Testing Materials, (1987) 1987 Annual Book of ASTM Standards, Votume 04.08, Soit and Rock; Building Stones, Philadelphia, 1189p.

Sureau of Rectamation, (1986), Amster K. Howard, <u>Geotechnical Branch</u>
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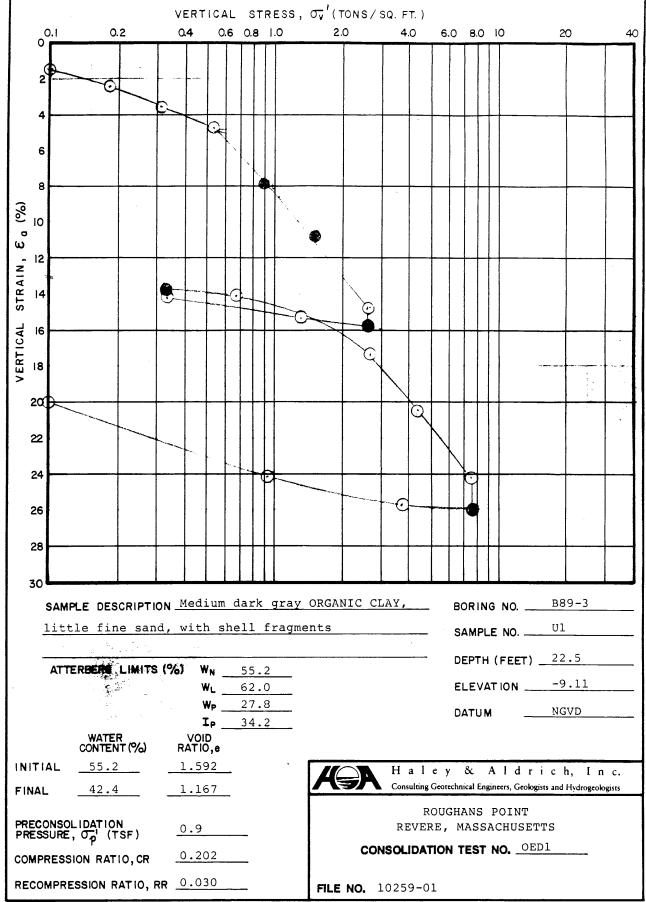
Haley & Aldrich, Inc. Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ROUGHANS POINT REVERE, MASSACHUSETTS:

GENERAL GEOTECHNICAL LABORATORY SOIL TEST PROGRAM NOTES

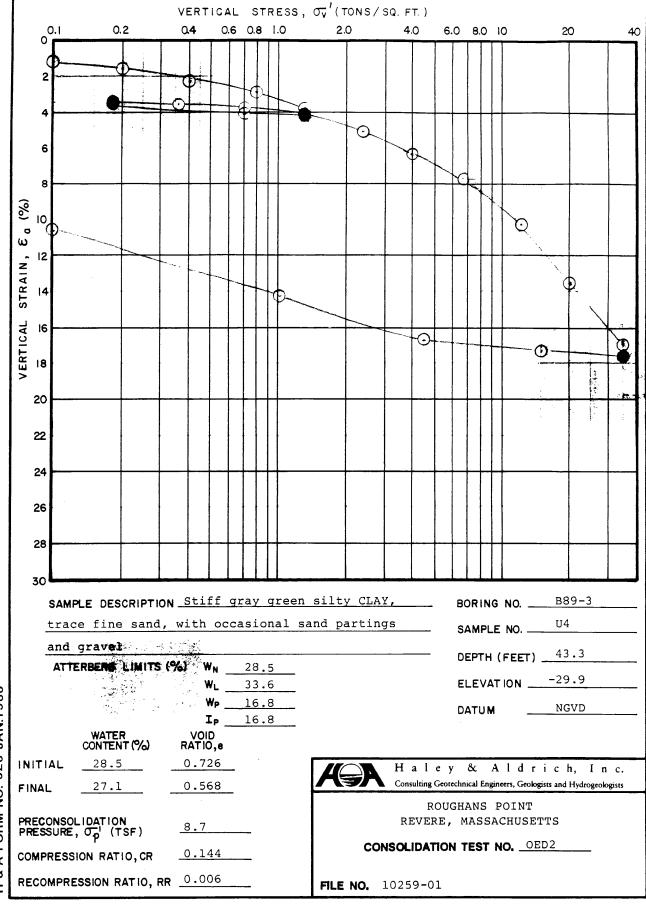
FEBRUARY 1990

PROJE	CT:	Roughan								FILE NO. DATE: TEST No.	10259-0 12-26-8 0ED1
		kevere,	Massach	usetts					1	CALC. BY:	FJP/RCC
EXPL.	No.:	889-3		SA	MPLE DESI	CRIPTION:	Soft don	k gaar oncento or ev		CHCKD.BY:	GY
SAMPLE	No.:	U-1				5	SOIL Gai	k gray ORGANIC CLAY			
DEPTH	(ft.)	22.5		AT	TERBERG I	LIMITS (%):	WL =	62.0 IP = 34.2	,		
							wP =	27.8 IL = 0.8	1		
									STRESS	STRAIN PARAMET	ERS:
IATED	CONTENT	. W.	INITIAL			ality:	{ } Exce	llent	j		
	CONTENT F SAT. (55.19	42.41			{ } Very	Good	Pr	econsolidation	
	HT. (cm		95.4	100.0			{ } Good		Pr	essure, sig'p	0.9
	DIAMETE		1.898 6.345	1.587			{X} Fair			CR =	0.202
	AREA (SO		31.619				{ } Poor			RR =	0.030
	MPLE WT.		98.870		NOTES.	1 CD and	النمام 00	seed on the st			
	MPLE WT.		63.710		HOIES:			ted as the change in		erburden	
	NIT WT. (102.8			2. Specifi	areview	the change in log stress estimated assuming		ress, sig'vo=	1
	PECIFIC O		2.752					estimated assuming aturation S = 100%		rtical Strain	
	ATIO, e		1.592	1.167			-31-00 01-3	- IUUA	l at	sig'vo=	
	HT. (cm)		0.732						1		
	• • • • • • • • •										
					STRESS	COEFF.	COEFF.		LOG STRE	SS	
INC.	VERT.	VERT		VOID	RATIO	CONS.,cv	SEC.		RATIO		
No.	STRESS	STRAIN				(sqcm/sec)	COMPR.		log (sig'v	c/ REMARKS	;
4	(tsf)	(EOP)	(EOI)		sig'p)		(%)		sig'p		
1 2	0.06	1.12	1.17	1.563		1.64E-03			-1.1760		
3	0.10 0.18	1.48	1.58	1.554		2.88E-03			-0.9542		
4	0.18	2.34 3.41	2.57	1.532		1.60E-03			-0.6989		
5	0.53	4.75	3.83 4.97	1.504		1.56E-03			-0.4628		
6	0.90	4.75	7.97	1.409	0.569	1.52E-03	0.3000		-0.2299		
7	1.53		10.85								
8	2.60	14.70	15.75	1.211	2 880	7.11E-04	1 1745				
9	1.30	15.34	15.35	1.195		2.37E-03			0.46073		
10	0.33	14.16	13.80	1.225		6.79E-04			0.15970		
11	0.66	14.10	14.12	1.227		2.46E-03			-0.4357		
12	1.30	15.34	15.65	1.195		2.15E-03			-0.1346		
13	2.60	17.28	17.42	1.144		2.91E-03			0.15970		
14	4.42	20.50	21.70	1.061		4.35E-04			0.46073 0.69117		
15	7.51	24.00	26.05	0.970		9.90E-04			0.92139		
16	3.76	25.88	25.81	0.921		5.12E-03			0.62036		
17	0.94	24.13	23.56	0.967			0.1786		0.01842		
18	0.10	19.95	19.20	1.075	0.111	5.72E-04	1.1905		-0.9542		
19	seating		16.40								



& A FORM NO. 520 JAN.1986

						· · · · · · · · · · · · · · · · · · ·				E No.	10259-01
PROJECT	r •	Roughans	s Point						DAT	E: T No.	12-29-89 OED2
,	•	-	Massachi	usetts					<u>.</u>	C. BY:	FJF/RCC
										KD.BY:	GY
EXPL. N	10.:	B89-3		SAI	MPLE DESCR	RIPTION:	Gray green	n silty CLAY with some			· .
SAMPLE	No.:	U-4					medium to	fine sand	i		
DEPTH ((ft.)	43.3		AT'	TERBERG L	MITS (%):	WL =	33.6 IP = 16.8	i		
							wP =	16.8 IL = 0.7	į		
									 STRESS STRA	IN DADAMET	FDQ.
			INITIAL	FINAL	Test Qua	lity:	() Excell	ent	318233 3188	IN FARABLI	LKJ.
WATER C	CONTENT (%)	28.45	27.10		,	{ } Very (l Precon	solidation	1
	SAT. (%	-	105.0	127.9			{ } Good		:	re, sig'p	8.7 t:
	HT. (cm)	-	1.905	1.730			(X) Fair			CR =	0.144
	DIAMETER		6.344				() Poor		i	RR =	0.006
	AREA (SC		31.609						i	••••	
	PLE WT.	•	120.100		NOTES: 1	. CR and F	RR calculat	ted as the change in	0verbu	rden	
	PLE WT.		93.500					the change in log stress		, sig'vo=	ts
	 (IT WT. (-	124.5		2			estimated assuming	•	al Strain	 '`
	PECIFIC O	•	2.681			•	-	aturation S = 100%	at sig		%
VOID RA			0.726	0.568					1	-	
	HT. (cm)	ı	1.104						1		
									·		
					STRESS	COEFF.	COEFF.		LOG STRESS		
INC.	VERT.	VERT	TICAL	VOID	RATIO	CONS.,cv	SEC.		RATIO		
No.	STRESS	STRAIR	(%)	RATIO, e	(sig'vc/	(sqcm/sec	COMPR.		log (sig'vc/	REMARK	S
	(tsf)	(EOP)	(EOI)	(EOP)	sig'p)		(%)		sig'p)		
1	0.06	1.31	1.30	0.704	0.007	5.87E-03	0.0042		-2.1613		
2	0.10	1.44	1.47	0.702	0.011	9.16E-03	0.0192		-1.9395		
3	0.20	1.89	1.92	0.694		2.88E-03			-1.6384		
4	0.40	2,27	2.43	0.687	0.046	1.61E-02	0.0543		-1.3374		
5	0.80	3.15	3.35	0.672	0.092	7.93E-03	0.0588		-1.0364		
6	1.40	3.85	4.18	0.660	0.161	8.75E-03	0.0625		-0.7933		
7	0.70	4.07	4.03	0.656	0.080	1.09E-02	0.0200		-1.0944		
8	0.18	3.49	3.41	0.666	0.021	3.90E-03	0.0700		-1.6842		
9	0.36	3.53	3.53	0.665	0.041	6.97E-03	0.0000		-1.3832		
10	0.70	3.78	3.82	0.661		8.74E-03			-1.0944		
11	1.40	4.25	4.36	0.653	0.161	8.67E-03	0.0036		-0.7933		
12	2.40	5.12	5.25	0.638	0.276	2.70E-03	0.0000		-0.5593		
13	4.00	6.31	6.41	0.617							
14	6.80	7.58	8.50	0.595		8.15E-03			-0.1070		
15	12.00	10.30	11.25	0.548		1.94E-03			0.13966		
16	20.00	13.50	14.10	0.493		2.29E-03			0.36151		
17	34.00	16.80	17.55	0.436		2.13E-03			0.59195		
18	15.00	17.23	17.21	0.429		1.02E-03			0.23657		
19	4.25	16.18	16.13	0.447		2.07E-03			-0.3111		
20	1.00	14.20	14.10	0.481		6.04E-03			-0.9395		
	0.10	10.75	10.65	0.541		1.62E-04			-1.9395		
21					0.000		0.0400				

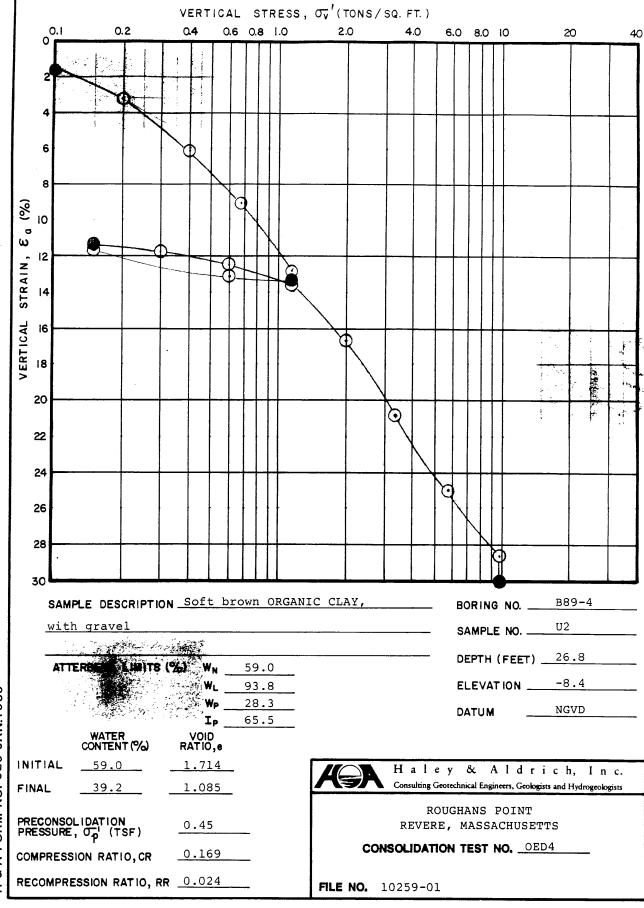


& A FORM NO. 520 JAN.1986

INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	9 () Very Good 0 (X) Good 4 () Fair () Poor NOTES: 1. CR and RR calculated as the change is strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	STRESS STRAIN PARAMETERS: Preconsolidation Pressure, sig'p 1.0 ts CR = 0.484 RR = 0.047 In Overburden Stress, sig'vo= ts Vertical Strain at sig'vo=
INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	fibrous PEAT TTERBERG LIMITS (%): wL = 186.5 IP = 73. wP = 113.2 IL = 0. Test Quality: { } Excellent 9	CALC. BY: FJF CHCKD.BY: GY CHC
INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	fibrous PEAT TTERBERG LIMITS (%): wL = 186.5 IP = 73. wP = 113.2 IL = 0. Test Quality: { } Excellent 9	CHCKD.BY: GY CHCKD.BY: GY CHCKD.BY: GY CHCKD.BY: GY CHCKD.BY: GY CR
INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	fibrous PEAT TTERBERG LIMITS (%): wL = 186.5 IP = 73. wP = 113.2 IL = 0. Test Quality: { } Excellent 9	STRESS STRAIN PARAMETERS: Preconsolidation Pressure, sig'p 1.0 ts CR = 0.484 RR = 0.047 Overburden Stress, sig'vo=ts Vertical Strain at sig'vo=%
INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	fibrous PEAT TTERBERG LIMITS (%): wL = 186.5 IP = 73. wP = 113.2 IL = 0. Test Quality: { } Excellent 9	STRESS STRAIN PARAMETERS: Preconsolidation Pressure, sig'p 1.0 ts CR = 0.484 RR = 0.047 Overburden stress. Stress, sig'vo=ts Vertical Strain at sig'vo=%
INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	TTERBERG LIMITS (%): wL = 186.5 IP = 73. wP = 113.2 IL = 0. Test Quality: { } Excellent 9	STRESS STRAIN PARAMETERS: Preconsolidation Pressure, sig'p 1.0 tmm CR = 0.484 RR = 0.047 In Overburden Stress, sig'vo=tmm Vertical Strain at sig'vo=x
INITIAL FINAL 128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	WP = 113.2 IL = 0. Test Quality: { } Excellent 9	STRESS STRAIN PARAMETERS: Preconsolidation Pressure, sig'p 1.0 ts CR = 0.484 RR = 0.047 Overburden Stress. Stress, sig'vo=ts Vertical Strain at sig'vo=x
128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	Test Quality: { } Excellent 9	STRESS STRAIN PARAMETERS: Preconsolidation Pressure, sig'p 1.0 ts CR = 0.484 RR = 0.047 Overburden Stress, sig'vo=ts Vertical Strain at sig'vo=%
128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	9 () Very Good 0 (X) Good 4 () Fair () Poor NOTES: 1. CR and RR calculated as the change is strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	Preconsolidation Pressure, sig'p 1.0 t CR = 0.484 RR = 0.047 Overburden stress. Stress, sig'vo=t Vertical Strain at sig'vo=%
128.58 111.89 89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	9 () Very Good 0 (X) Good 4 () Fair () Poor NOTES: 1. CR and RR calculated as the change is strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	Pressure, sig'p 1.0 to CR = 0.484 RR = 0.047 In Overburden stress. Stress, sig'vo=ts Vertical Strain at sig'vo=%
89.0 100.0 1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	O (X) Good 4 () Fair {) Poor NOTES: 1. CR and RR calculated as the change i strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	Pressure, sig'p 1.0 to CR = 0.484 RR = 0.047 In Overburden stress. Stress, sig'vo=to Vertical Strain at sig'vo=%
1.896 1.564 6.340 31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	4 () Fair () Poor NOTES: 1. CR and RR calculated as the change i strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	CR = 0.484 RR = 0.047 in Overburden stress. Stress, sig'vo=ts Vertical Strain at sig'vo=%
6.340 31.570 73.490 32.150 76.6 2.400 3.468 0.424	<pre>NOTES: 1. CR and RR calculated as the change i</pre>	n Overburden stress. Stress, sig'vo=t: Vertical Strain at sig'vo=%
31.570 73.490 32.150 76.6 2.400 3.468 2.685 0.424	NOTES: 1. CR and RR calculated as the change is strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	in Overburden stress. Stress, sig'vo=t: Vertical Strain at sig'vo=%
73.490 32.150 76.6 2.400 3.468 2.685 0.424	strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	stress. Stress, sig'vo=t: Vertical Strain at sig'vo=%
32.150 76.6 2.400 3.468 2.685 0.424 TICAL VOID	strain divided by the change in log 2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	stress. Stress, sig'vo=t: Vertical Strain at sig'vo=%
76.6 2.400 3.468 2.685 0.424	2. Specific gravity estimated assuming final degree of saturation S = 100% STRESS COEFF. COEFF.	Vertical Strain at sig'vo= <u>%</u>
2.400 3.468 2.685 0.424 TICAL VOID	5 final degree of saturation S = 100% STRESS COEFF. COEFF.	at sig'vo=%
3.468 2.685 0.424 TICAL VOID	5 final degree of saturation S = 100% STRESS COEFF. COEFF.	
0.424 TICAL VOID	STRESS COEFF. COEFF.	
TICAL VOID		
		1.00 APARAG
		LOG STRESS
	RATIO CONS.,cv SEC.	RATIO
	e (sig'vc/ (sqcm/sec) COMPR.	log (sig'vc/ REMARKS
) sig'p) (%)	sig'p)
0.15 3.462		-1.2218
0.37 3.457		-1
1.06 3.436	6 0.200 2.33E-03 0.1618	-0.6989
2.16 3.389	9 0.400 3.19E-03 0.2513	-0.3979
4.43 3.291	1 0.800 1.85E-03 0.4563	-0.0969
11.69 3.102	2 1.400 7.40E-04 3.0682	0.14612
10.51 2.985	5 0.700 1.03E-03 0.2568	-0.1549
6.59 3.122	2 0.180 3.48E-04 0.7991	-0.7447
7.07 3.158	8 0.360 2.05E-03 0.1016	-0.4436
8.94 3.110	0 0.700 1.80E-03 0.3505	-0.1549
12.96 2.986	6 1.400 1.07E-03 0.8975	0.14612
		0.38021
31.70 2.253	3 4.000 1.84E-04 2.7222	0.60205
30.66 2.084	4 2.000 5.35E-04 0.1708	0.30102
25.90 2.261	1 0.500 5.98E-05 0.9706	-0.3010
21.17 2.501	1 0.100 2.45E-05 2.3920	-1
17.25		
	6.59 3.12 7.07 3.15 8.94 3.11 12.96 2.98 22.89 2.59 31.70 2.25 30.66 2.08 25.90 2.26 21.17 2.50	6.59 3.122 0.180 3.48E-04 0.7991 7.07 3.158 0.360 2.05E-03 0.1016 8.94 3.110 0.700 1.80E-03 0.3505 12.96 2.986 1.400 1.07E-03 0.8975 22.89 2.596 2.400 1.03E-04 2.9523 31.70 2.253 4.000 1.84E-04 2.7222 30.66 2.084 2.000 5.35E-04 0.1708 25.90 2.261 0.500 5.98E-05 0.9706 21.17 2.501 0.100 2.45E-05 2.3920

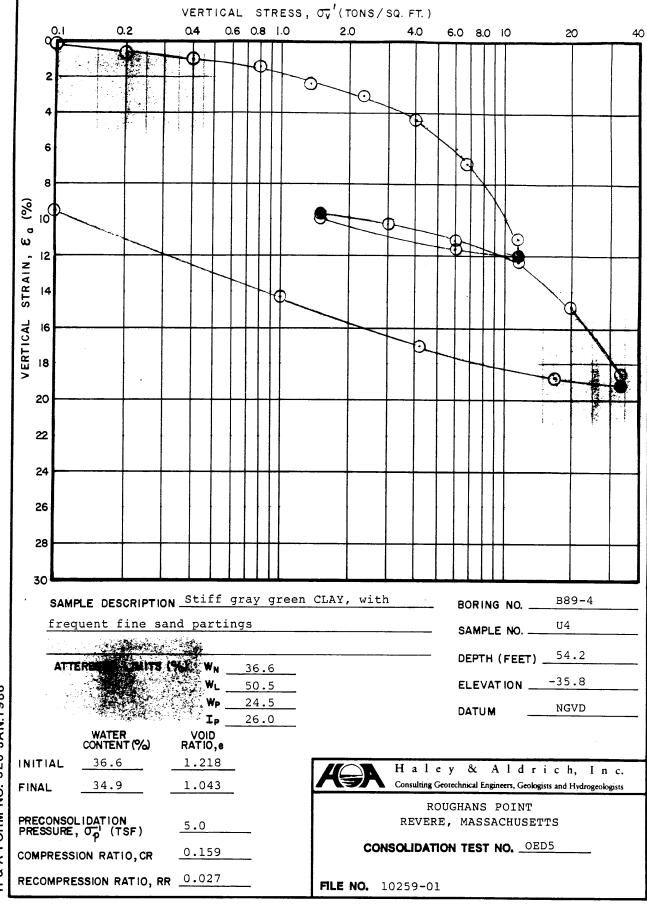
Š. FORM

HALEY		-						SUMMARY	- 1		
										FILE No.	10259-01
	_								1	DATE:	FEB 1990
PROJEC	1:	Roughans								TEST No.	OED4
		Revere,	Massach	usetts					i	CALC. BY:	99
									1	CHCKD.BY:	gy
EXPL.		B89-4		SA	MPLE DESC	RIPTION:	Very soft	to soft ORGANIC CLAY	1		
SAMPLE		U2							1		
DEPTH	(ft.)	12.8		AT	TERBERG L	.IMITS (%):	WL =	93.8 IP = 65.5	!		
							wP =	28.3 IL = 0.5	1		
											·
			INITIAL	FINAL	Test Qu	ality:	{ } Excell	ent	STRESS	STRAIN PARAMET	ERS:
WATER (CONTENT	(%)	58.95	39.15		-	{ } Very G		l Dr	econsolidation	
DEG. O	F SAT. (()	95.3	100.0			{x} Good				
SAMPLE	HT. (cm))	1.905	1.463			{ } Fair		1 61	essure, sig'p	
	DIAMETER		6.353				{ } Poor		1	CR =	0.169
	AREA (so		31.699				. ,		! !	RR =	0.024
	MPLE WT.	•	97.960		NOTES:	1. CR and G	R calculat	ed as the change in	~.	anhunda-	
	MPLE WT.	. • .	61.630					the change in log stress		erburden	
	NIT WT. (-	101.3			_		stimated assuming	:	ress, sig'vo=	t
	PECIFIC O		2.770					turation S = 100%		rtical Strain	
OID RA	ATIO, e		1.714	1.085			.g. 00 0. 00	Cal a C 00%	i at	sig'vo=	x
	HT. (cm))	0.702						1		
									 	•	
					STRESS	COEFF.	COEFF.		LOG STRE	ESS	
INC.	VERT.	VERT	ICAL	VOID	RATIO	CONS.,cv	SEC.		RATIO		
No.	STRESS	STRAIN	(%)	RATIO, e	(sig'vc/	(sqcm/sec)	COMPR.		log (sig'	c/ REMARKS	S
	(tsf)	(EOP)	(EOI)	(EOP)	sig'p)		(%)		sig'p)	
1	0.06		0.76						-		
2	0.10		1.56								
3	0.20	3.42	4.05	1.621	0.444	2.52E-04	1.0500		-0.3521		
4	0.40	6.04	6.80	1.550	0.889	3.97E-04	1.1300		-0.0511		
5	0.68	9.00	10.40	1.470	1.511	2.83E-04	1.3000		0.17929		
6	1.20	12.70	13.39	1.369	2.667	3.29E-04	1.3300		0.42596		
7	0.60	13.17	13.16	1.357	1.333	1.59E-03	0.0050		0.12493		
8	0.15	11.83	11.62	1.393	0.333	3.45E-04	0.1400		-0.4771		
9	0.30	11.88	12.04	1.392	0.667	1.46E-03	0.0650		-0.1760		
10	0.60	12.60	12.89	1.372	1.333	1.41E-03	0.1340		0.12493		
11	1.20	13.70	14.89	1.342	2.667	1.48E-03	0.4500		0.42596		
12	2.00	16.60	18.10	1.264	4.444	4.17E-04	0.9600		0.64781		
13	3.40	20.90	22.45	1.147	7.556	3.32E-04	0.9500		0.87826		
14	5.78	24.80	26.00	1.041	12.844	2.98E-04	0.9500		1.10871		
15	9.83	28.50	30.00	0.941	21.844	4.65E-04	1.2000		1.33934		
16	4.92	29.84	29.77	0.904	10.933	3.67E-03	0.0260		1.03875		
17	1.23	29.02	28.62	0.926	2.733	1.00E-03	0.1950		0.43669		
18	0.15	26.18	25.50	1.004	0.333	8.24E-04	0.7600		-0.4771		
19	seating		23.18								



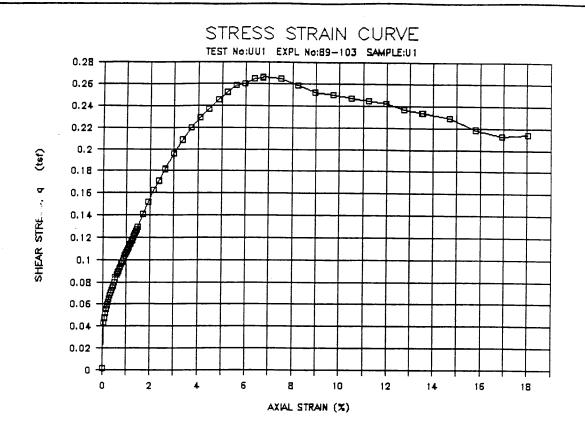
H & A FORM NO. 520 JAN.198

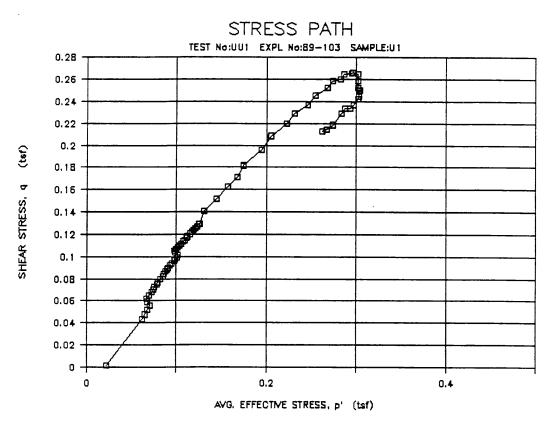
										LE No.	10259-01
PROJEC1	Γ:	Roughan	s Point						:	TE: ST No.	FEB 1990 OED5
		-	Massach	usetts					:	LC. BY:	gy
		~								CKD.BY:	97 97
EXPL. N	io.:	B89-4		SAI	MPLE DESCI	RIPTION:	Stiff gray s	reen silty CLAY with	ĺ		•
SAMPLE	No.:	U 4					fine sand pa	artings	1		
DEPTH ((ft.)	54.2		AT:	TERBERG L	IMITS (%):		$0.5 ext{ IP} = 26.0$	1		
							₩P = 24	5 IL = 0.5			
									STRESS STR	AIN PARAME	TERS:
			INITIAL	FINAL	Test Qua	ality:	{ } Exceller	nt	1		
	CONTENT (36.57	34.90			{ } Very Goo	od .	Preco	nsolidatio	1
	SAT. (%	-	89.7	100.0			{x} Good		Press	ure, sigʻp	5.0 ts
	HT. (cm)		1.905	1. <i>7</i> 55			{ } Fair		1	CR =	0.159
	DIAMETER		6.347				() Poor		Ļ	RR =	0.027
	AREA (so		31.639						į		
	PLE WT.	_	110.850		NOTES:			ias the change in	0verb		
	IPLE WT.	_	81.170		=			ne change in log stress		s, sig'vo=	ts
	IIT WT. (•	114.8		2	•	- •	imated assuming	•	cal Strain	
	ECIFIC G	KAVITY	2.987	4		final de	egree of satu	ration S = 100%	atsi	g'vo=	x
	TIO, e		1.218	1.043					ļ		
SOLIDS	HT. (cm)		0.859						 		
					STRESS	COEFF.	COEFF.		LOG STRESS		
INC.	VERT.	VER	TICAL	VOID	RATIO	CONS.,cv	SEC.		RATIO		
No.	STRESS	STRAIR	N (%)	RATIO, e	(sig'vc/	(sqcm/sec)	COMPR.		log (sig'vc/	REMARI	(S
	(tsf)	(EOP)	(EOI)	(EOP)	sig'p)		(%)		sig'p)		
1	0.06		0.04								
2	0.10	0.13	0.14	1.215	0.020	4.71E-03	0.0200		-1.69 89		
3	0.20	0.57		1.205	0.040				-1.3979		
4	0.40	0.95	1.00	1.197	0.080	1.85E-03			-1.0969		
5	0.80	1.58		1.183		3.65E-03			-0.7958		
6	1.40	2.21	2.36	1.169	0.280				-0.5528		
7	2.40	3.00	3.22	1.151	0.480				-0.3187		
8	4.00	4.42	4.90	1.120	0.800	1.74E-03			-0.0969		
9	6.80	6.90	7.59	1.065		1.32E-03			0.13353		
10	12.00	11.20	12.00	0.970		1.09E-03			0.38021		
11	6.00	11.58	11.53	0.961		4.62E-03			0.07918		
12	1.50	9.97		0.997		1.33E-03			-0.5228		
13	3.00 6.00	10.20 11.08	10.23	0.992 0.972		2.41E-03 2.99E-03			-0.2218		
14 15	12.00		11.15 12.60	0.945		3.43E-03			0.07918 0.38021		
16	20.00	12.32 14.88	14.50	0.888							
17	34.00	18.55	19.20	0.807		3.07E-04			0.60205 0.8325 0		
18	17.00	18.79	18.72	0.801		6.18E-03			0.53147		
19	4.25	17.02	16.90	0.840		1.42E-03			-0.0705		
20	1.00	14.20	14.02	0.903		3.78E-04			-0.6989		
21	0.10	9.75	9.50	1.002		1.16E-04			-1.6989		
- 1	0.10	,.,,	7.90		J. ULU		3.4000		1.0707		



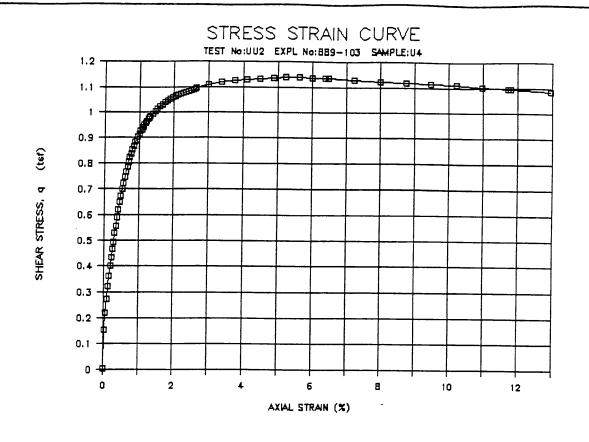
H & A FORM NO. 520 JAN.1986

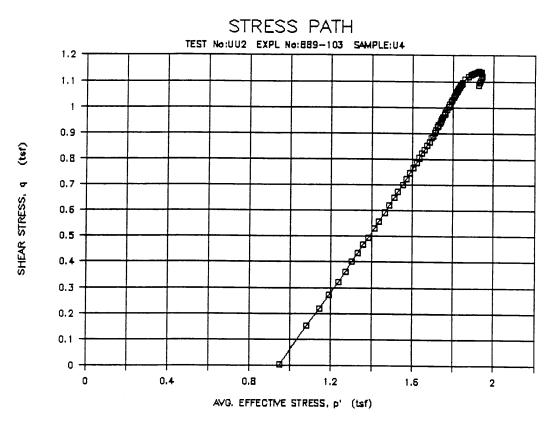
HALEY & ALDRI	CH, INC.		UNCONSO	LIDATED UNDR	RAINED CO	MPRESSION	TEST SUMM	\RY		TEST No.	UU1
PROJECT:	Roughans	Point							• • • • • • • • • • • • • • • • • • • •	FILE No.	10259-01
	Revere,	Massachuset	tts								
										DATE	Dec. 1989
				SAMPLE DESC	RIPTION:		ORGANIC				
EXPLORATION I	No.:B89-3					CLAY					
SAMPLE No.:	U1			477700500		(2.4		74.0			
DEPTH (ft.)	22.3			ATTERBERG L		wL= 02.0 wP= 27.8		34.2 0.6			
*****	******	******	******	******	*****	*****	******	******	******	*****	******
SAMPLE DIMENS	SIONS:										
		DOCCUEAD	CINAL		AMPLE QUA			DISPLACE	MENT RATE	(mm/min) (%/hour)	0.0619
heial	nt (cm)	PRESHEAR 7.970	7.149		{x}GOOD { }FAIR			AAIAL SI	IKAIN KAIE	(%/nour)	4.00
diam	eter (cm) (sq. cm)	3.537	3.898		{ }POOR						
		9.826 78.3102	11.934					DEAK III	NATHES		
votur	ne (cc)	10.3102	02.313/		UNIT			PEAK UND SHEAR ST			
WATER CONTENT	(%)	48.68	44.55			108.8		cu (tsf)		0.266	
******	******	******	******	******	*****	******	******	******		*******	
						÷					
				AV/C	41/0			2025	050447		
			SHEAR	AVG. EFFECTIVE	AVG. TOTAL	PORE	STRESS	PORE PRESS.	SECANT Young's		
ENTRY	AXIAL		STRESS,				,RATIO,	PARAM.	MODULUS,	R	REMARKS
No.	STRAIN		q	p'	Р	u	q/p'	A	E		
	(%)		(tsf)	(tsf)	(tsf)	(tsf)			(tsf)		
1	0.000		0.0018	0.0227	0.9892	0.9665	0.0793				
2	0.109		0.0515	0.0676	1.0390	0.9714	0.7627	0.0487	94.7		
3	0.219		0.0621	0.0673	1.0495		0.9223	0.1299	56.6		
4	0.328		0.0705	0.0743	1.0579		0.9481	0.1240	42.9		
5	0.438 0.544		0.0768 0.0841	0.0794 0.0863	1.0642 1.0716		0.9670 0.9754	0.1218 0.1139	35.1 30.9		
7	0.655		0.0899	0.0913	1.0773	0.9861	0.9849	0.1107	27.5		
8	0.765		0.0964	0.0976	1.0839		0.9885	0.1044	25.2		
9	0.877		0.1011	0.1021	1.0886		0.9902	0.1001	23.1		
10	0.987		0.1066	0.0996	1.0940	0.9944	1.0698	0.1328	21.6		
11	1.098		0.1115	0.1055	1.0990	0.9935	1.0577	0.1229	20.3		
12	1.210		0.1167		1.1041	0.9930	1.0502	0.1152	19.3		
13 14	1.322 1.433		0.1227 0.1273	0.1176 0.1230	1.1101 1.1147	0.9925 0.9918	1.0433 1.0353	0.1074 0.1005	18.6		
15	1.698		0.1408	0.1301	1.1283	0.9981	1.0820	0.1135	17.8 16.6		
16	2.374		0.1711	0.1676	1.1585	0.9909	1.0207	0.0719	14.4		
17	2.976		0.1963	0.1944	1.1837	0.9893	1.0095	0.0585	13.2		
18	4.093		0.2295	0.2313	1.2170	0.9857	0.9924	0.0420	11.2		
19	5.206		0.2523	0.2677	1.2397	0.9720	0.9424	0.0109	9.7		
20	5.972		0.2604	0.2820	1.2478	0.9658	0.9233	-0.0014	8.7		
21	6.724		0.2654	0.2943	1.2528	0.9585	0.9016	-0.0153	7.9		
22	7.485		0.2651	0.3019	1.2526	0.9506	0.8781	-0.0302	7.1		
23	8.971		0.2524	0.3013	1.2398	0.9385	0.8375	-0.0560	5.6		
24 25	10.485 11.987		0.2468 0.2425	0.3026 0.3016	1.2342 1.2299	0.9316 0.9283	0.8156	-0.0713	4.7		
25 26	13.495		0.2425	0.3016	1.2213	0.9286	0.8039 0.7991	-0.0795 -0.0817	4.0 3.5		
27	13.532		0.2337	0.2867	1.2211	0.9345	0.8153	-0.0691	3.5		
28	16.910		0.2133	0.2624	1.2007	0.9383	0.8129	-0.0667	2.5		
29	17.996		0.1892	0.3706	1.3058	0.9352	0.5106	-0.0866	2.1		
					····						



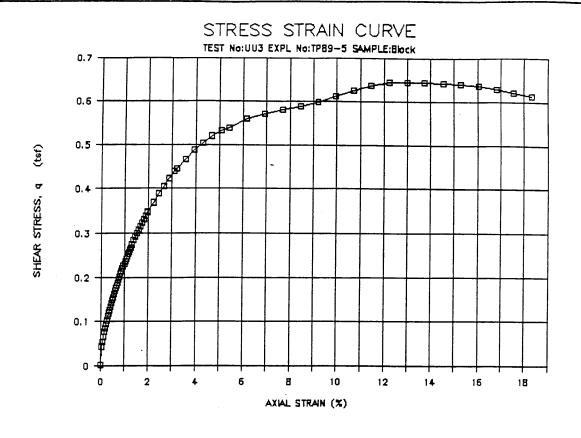


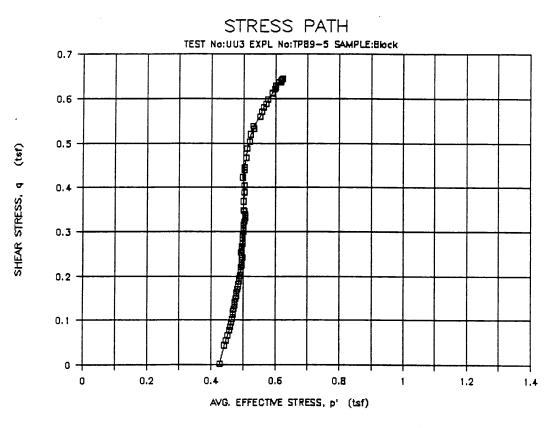
HALEY & ALDRICH, INC. UNCONSOLIDATED UNDRAINED COMPRESSION TEST SUMMARY TEST No. UU2 PROJECT: Roughans Point FILE No. 10259-01 Revere, Massachusetts DATE Jan. 1990 SAMPLE DESCRIPTION: Stiff gray green silty CLAY, trace fine sand. EXPLORATION No.: B89-3 SAMPLE No.: ATTERBERG LIMITS: WL= 33.6 WP= 16.8 DEPTH (ft.) IL= SAMPLE DIMENSIONS: SAMPLE QUALITY DISPLACEMENT RATE (mm/min) 0.0595 PRESHEAR FINAL { }GOOD AXIAL STRAIN RATE (%/hour) 4.49 7.959 height (cm) 6.780 {x}FAIR diameter (cm) 3.634 3.972 { }POOR 12.391 area (sq. cm) 10.372 volume (cc) 82.5502 84.0114 PEAK UNDRAINED TOTAL UNIT SHEAR STRENGTH, WATER CONTENT (%) 25.33 WEIGHT (pcf): 126.5 cu (tsf): 1.138 AVG. PORE SECANT SHEAR EFFECTIVE TOTAL STRESS PORE PRESS. YOUNG'S **ENTRY** AXIAL STRESS, STRESS, STRESS, PRESSURE, RATIO, PARAM. MODULUS, REMARKS No. STRAIN p′ Р q/p' A Е (%) (tsf) (tsf) (tsf) (tsf) (tsf) 0.000 0.0017 0.9506 0.8617 -0.08890.0018 * PORE PRESSURE 0.099 0.2740 1.1339 1.1923 -0.0584 0.2298 0.0561 552.3 READINGS NOT 0.198 3 0.4010 1.3025 1.2610 -0.0415 0.3079 0.0594 405.8 RELIABLE 0.285 0.4960 1.3810 1.3560 -0.0250 0.3592 347.6 0.0647 5 0.385 0.5923 1.4617 1.4523 -0.0095 0.4052 0.0673 308.0 0.491 0.6730 1.5272 1.5330 0.0058 0.4407 0.0706 274.0 0.601 0.7467 1.5869 1.6067 0.0197 0.4705 0.0729 248.5 8 0.710 0.8047 1.6323 1.6647 0.0756 0.0324 0.4930 226.7 9 0.818 0.8541 1.6707 1.7140 0.0433 0.5112 0.0776 208.8 10 0.926 0.8908 1.6978 1.7507 0.0529 0.5246 0.0798 192.3 11 1.038 0.9247 1.7224 1.7846 0.0622 0.5368 0.0819 178.1 12 1.147 0.9478 1.7374 1.8077 0.0703 0.5455 0.0842 165.2 1.258 0.9713 13 1.7540 1.8312 0.0772 0.5537 0.0857 154.4 14 1.379 0.9934 1.7697 1.8534 0.0837 0.5613 0.0870 144.0 15 1.600 1.0221 1.7892 1.8821 0.0929 0.5713 0.0891 127.7 16 1.822 1.0465 1.8069 1.9065 0.0996 0.5792 0.0902 17 2.044 1.0638 1.9238 1.8184 0.1054 0.5850 0.0915 104.1 2.265 18 1.0755 1.8271 1.9355 0.1084 0.5887 0.0919 95.0 19 2.485 1.0861 1.8366 1.9461 0.1095 0.5914 0.0915 87.4 20 2.631 1.0931 1.8426 1.9530 0.1104 0.5932 0.0913 83.1 3.002 21 1.1075 1.8581 0.1094 1.9675 0.5960 0.0897 73.8 22 3.738 1.1256 1.8853 1.9855 0.1002 0.5970 0.0842 60.2 23 4.487 1.1317 1.9050 1.9917 0.0867 0.5941 0.0777 50.4 24 5.242 1.1378 1.9230 1.9978 0.0748 0.5917 0.0720 43.4 25 6.002 1.1361 1.9322 1.9961 0.0640 0.5880 0.0674 37.9 26 6.476 1.1339 1.9361 1.9939 0.0577 0.5857 0.0648 35.0 27 7.232 1.1270 1.9386 1.9870 0.0484 0.5814 0.0610 31.2 28 9.475 1.1149 1.9405 1.9749 0.0344 0.5745 0.0554 23.5 29 11.727 1.0951 1.9292 1.9550 0.0258 0.5676 0.0525 18.7 12.951 1.0002 1.9855 2.0081 0.0226 0.5038 0.0476 15.4



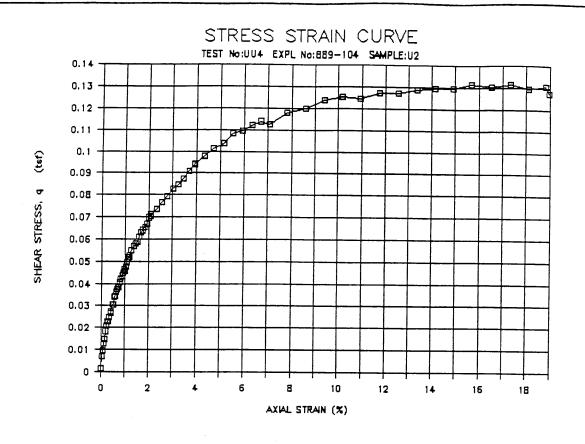


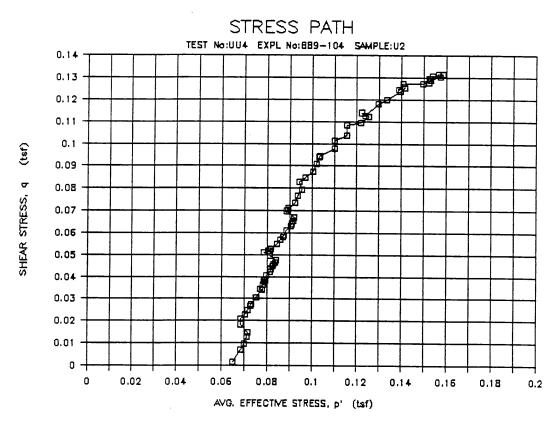
PRESHE () 7.86 (cm) 9.69 () 76.296	**************************************	SAMPLE DESC	CRIPTION:	Dark brown L= 186.5 P= 113.2	PEAT IP= IL=			TEST NO.	10259-01
89-5 ock 1 3	**************************************	SAMPLE DESC	-IMITS: w	⊮L= 186.5 ⊮P= 113.2	IP= IL=	73.3 0.1			
89-5 ock 1 3 ***********************************	**************************************	SAMPLE DESC	-IMITS: w	⊮L= 186.5 ⊮P= 113.2	IP= IL=	73.3 0.1			
ock 1 3 ***********************************	**************************************	ATTERBERG L	-IMITS: w	⊮L= 186.5 ⊮P= 113.2	IP= IL=	73.3 0.1	!	DATE	JAN 1990
ock 1 3 ***********************************	**************************************	ATTERBERG L	-IMITS: w	⊮L= 186.5 ⊮P= 113.2	IP= IL=	73.3 0.1			
ock 1 3 ***********************************	**************************************	*********	******			73.3 0.1			
PRESHE	**************************************	*********	******			73.3 0.1			
**************************************	**************************************	*********	******			0.1			
PRESHE	AR FINAL 7 6 911	S		*****	*****				
PRESHE	AR FINAL 7 6.911 4 3.629	Ş	SAMPLE OU			*****	******	*****	******
PRESHE 7.86 cm) 3.51 cm) 9.69) 76.296	AR FINAL 7 6.911 4 3.629	\$	AMPLE DIA						
7.86 cm) 3.51 cm) 9.69) 76.296	7 6.911 4 3.629		{ }G000	LITY		DISPLACE	MENT RATE	(mm/min) (%/hour)	0.0596
cm) 3.51 cm) 9.69) 76.296	4 3.629		{x}FAIR			WINE 31	WATE SAIE	(A/HOUL)	4.34
76.296	9 10 7/7		{ }POOR						
	1 71.4833					PEAK UND	RAINED		
		TOTAL	UNIT			SHEAR ST	RENGTH.		
121.6	9 118.69	WEIGH	IT (pcf):	81.7		cu (tsf)	:	0.645	
*****	*****	*******	******	******	******	******	******	******	*****
	CUEAR	AVG. Effective			CTOPOO		SECANT		
IAL	STRESS,	STRESS,	STRESS,	PRESSURE	,RATIO,	PRESS.	MODULUS,	R	EMARKS
RAIN	q	p' (tsf)	p	u	q/p'	A	E	.,	
%)			(tst)	(tsf)			(tsf)		
.000	0.0018 0.0657	0.4273	0.6500		0.0043				
.109			0.7139	0.2612	0.1451		120.0		
.223 .337	0.0950 0.1193	0.4634 0.4692	0.7432 0.7675	0.2798 0.2983	0.2051 0.2544	0.3065 0.3218	85.3 70.9		
.450	0.1410	0.4748	0.7891	0.3144	0.2969	0.3294	62.6		
.531	0.1558	0.4784	0.8039	0.3255	0.3256	0.3340	58.7		
.643	0.1765	0.4837		0.3409	0.3649	0.3385	54.9		
. <i>7</i> 58 .870	0.1959 0.2144	0.4882 0.4922	0.8441 0.8626	0.3559 0.3704	0.4012 0.4356	0.3431 0.3473	51.7 49. 3		
	0.2480	0.4950	0.8962	0.4012	0.5010	0.3626	45.2		
.210		0.4951	0.9117				43.5		
.809									
.974	0.3486	0.5014	0.9968	0.4955	0.6954	0.3932	35.3		
.648		0.5036		0.5496	0.8042	0.4053	30.6		
			1.0935				27.9		
.065									
.148	0.5592	0.5514		0.6560	1.0142		18.2		
	0.5804	0.5637	1.2285	0.6648	1.0295	0.3821	15.1		
.680						0.3742	13.0		
.680 .199									
.680 .199 .714	0.6454	0.6223	1.2936	0.6713	1.0332				
.680 .199	0.6433	0.6189	1.2915	0.6725	1.0393	0.3506	8.9		
.680 .199 .714 .230 .749		0.5910	1.2769	0.6706	1.0380	0.3662	6.7		
23.5	362 585 309 974 548 187 514 965 148 880 199 714 7330	210 0.2635 362 0.2838 585 0.3077 809 0.3317 974 0.3486 548 0.4051 187 0.4453 314 0.5036 165 0.5326 148 0.5592 148 0.5982 199 0.5982 114 0.6251 230 0.6445	210 0.2635 0.4951 362 0.2838 0.4987 585 0.3077 0.5002 389 0.3317 0.5048 674 0.3486 0.5014 648 0.4051 0.5036 187 0.4453 0.5039 314 0.5036 0.5193 314 0.5036 0.5126 314 0.5036 0.5129 314 0.5592 0.5514 380 0.5804 0.5637 199 0.5982 0.5773 714 0.6251 0.6006 230 0.6445 0.6237 749 0.6454 0.6223 3621 0.6433 0.6189	210 0.2635 0.4951 0.9117 362 0.2838 0.4987 0.9320 585 0.3077 0.5002 0.9559 309 0.3317 0.5048 0.9759 974 0.3486 0.5014 0.9968 548 0.4051 0.5036 1.0532 187 0.4453 0.5039 1.0935 314 0.5036 0.5193 1.1518 065 0.5326 0.5325 1.1807 148 0.5592 0.5514 1.2074 580 0.5804 0.5637 1.2285 199 0.5982 0.5773 1.2464 714 0.6251 0.6006 1.2733 230 0.6445 0.6237 1.2927 749 0.6454 0.6237 1.2927 321 0.6433 0.6189 1.2915	210 0.2635 0.4951 0.9117 0.4166 362 0.2838 0.4987 0.9320 0.4334 585 0.3077 0.5002 0.9559 0.4557 389 0.3317 0.5048 0.9799 0.4751 974 0.3486 0.5014 0.9968 0.4955 648 0.4051 0.5036 1.0532 0.5496 187 0.4453 0.5039 1.0935 0.5896 314 0.5036 0.5193 1.1518 0.6324 165 0.5326 0.5325 1.1807 0.6482 148 0.5592 0.5514 1.2074 0.6560 580 0.5804 0.5637 1.2285 0.6648 199 0.5982 0.5773 1.2464 0.6691 714 0.6251 0.6006 1.2733 0.6726 230 0.6445 0.6237 1.2927 0.6689 749 0.6454 0.6223 1.2936 0.6713	210 0.2635 0.4951 0.9117 0.4166 0.5322 362 0.2838 0.4987 0.9320 0.4334 0.5692 585 0.3077 0.5002 0.9559 0.4557 0.6152 309 0.3317 0.5048 0.9799 0.4751 0.6571 974 0.3486 0.5014 0.9968 0.4955 0.6954 648 0.4051 0.5036 1.0532 0.5496 0.8042 187 0.4453 0.5039 1.0935 0.5896 0.8837 314 0.5036 0.5193 1.1518 0.6324 0.9697 365 0.5326 0.5325 1.1807 0.6482 1.0001 448 0.5592 0.5514 1.2074 0.6560 1.0142 580 0.5804 0.5637 1.2285 0.6648 1.0295 199 0.5982 0.5773 1.2464 0.6691 1.0361 714 0.6251 0.6006 1.2733 0.6726 <td>210 0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 362 0.2838 0.4987 0.9320 0.4334 0.5692 0.3735 585 0.3077 0.5002 0.9559 0.4557 0.6152 0.3809 309 0.3317 0.5048 0.9799 0.4751 0.6571 0.3825 648 0.4051 0.5036 1.0532 0.5496 0.8042 0.4053 187 0.4453 0.5039 1.0935 0.5896 0.8837 0.4136 365 0.5326 0.5325 1.1518 0.6324 0.9697 0.4083 365 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 468 0.5952 0.5514 1.2074 0.6520 1.0142 0.3887 365 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 468 0.5992 0.5514 1.2074 0.6520 1.0142 0.3887 <td< td=""><td>210 0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 43.5 362 0.2838 0.4987 0.9320 0.4334 0.5692 0.3735 41.7 585 0.3077 0.5002 0.9559 0.4557 0.6152 0.3809 38.8 389 0.3317 0.5048 0.9799 0.4751 0.6571 0.3825 36.7 974 0.3486 0.5014 0.9968 0.4955 0.6954 0.3932 35.3 648 0.4051 0.5036 1.0532 0.5496 0.8042 0.4053 30.6 187 0.4453 0.5039 1.0935 0.5896 0.8837 0.4136 27.9 314 0.5036 0.5193 1.1518 0.6324 0.9697 0.4083 23.3 365 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 21.0 448 0.5592 0.5514 1.2074 0.6560 1.0142 0.3887 18.2</td><td>210 0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 43.5 362 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0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 43.5 362 0.2838 0.4987 0.9320 0.4334 0.5692 0.3735 41.7 585 0.3077 0.5002 0.9559 0.4557 0.6152 0.3809 38.8 389 0.3317 0.5048 0.9799 0.4751 0.6571 0.3825 36.7 974 0.3486 0.5014 0.9968 0.4955 0.6954 0.3932 35.3 648 0.4051 0.5036 1.0532 0.5496 0.8042 0.4053 30.6 187 0.4453 0.5039 1.0935 0.5896 0.8837 0.4136 27.9 314 0.5036 0.5193 1.1518 0.6324 0.9697 0.4083 23.3 365 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 21.0 448 0.5592 0.5514 1.2074 0.6560 1.0142 0.3887 18.2</td><td>210 0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 43.5 362 0.2838 0.4987 0.9320 0.4334 0.5692 0.3735 41.7 585 0.3077 0.5002 0.9559 0.4557 0.6152 0.3809 38.8 389 0.3317 0.5048 0.9799 0.4751 0.6571 0.3825 36.7 974 0.3486 0.5014 0.9968 0.4955 0.6954 0.3932 35.3 648 0.4051 0.5036 1.0532 0.5496 0.8042 0.4053 30.6 187 0.4453 0.5039 1.0935 0.5896 0.8837 0.4136 27.9 314 0.5036 0.5193 1.1518 0.6324 0.9697 0.4083 23.3 1055 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 21.0 148 0.5592 0.5514 1.2074 0.6560 1.0142 0.3887 18.</td></td<>	210 0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 43.5 362 0.2838 0.4987 0.9320 0.4334 0.5692 0.3735 41.7 585 0.3077 0.5002 0.9559 0.4557 0.6152 0.3809 38.8 389 0.3317 0.5048 0.9799 0.4751 0.6571 0.3825 36.7 974 0.3486 0.5014 0.9968 0.4955 0.6954 0.3932 35.3 648 0.4051 0.5036 1.0532 0.5496 0.8042 0.4053 30.6 187 0.4453 0.5039 1.0935 0.5896 0.8837 0.4136 27.9 314 0.5036 0.5193 1.1518 0.6324 0.9697 0.4083 23.3 365 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 21.0 448 0.5592 0.5514 1.2074 0.6560 1.0142 0.3887 18.2	210 0.2635 0.4951 0.9117 0.4166 0.5322 0.3704 43.5 362 0.2838 0.4987 0.9320 0.4334 0.5692 0.3735 41.7 585 0.3077 0.5002 0.9559 0.4557 0.6152 0.3809 38.8 389 0.3317 0.5048 0.9799 0.4751 0.6571 0.3825 36.7 974 0.3486 0.5014 0.9968 0.4955 0.6954 0.3932 35.3 648 0.4051 0.5036 1.0532 0.5496 0.8042 0.4053 30.6 187 0.4453 0.5039 1.0935 0.5896 0.8837 0.4136 27.9 314 0.5036 0.5193 1.1518 0.6324 0.9697 0.4083 23.3 1055 0.5326 0.5325 1.1807 0.6482 1.0001 0.4009 21.0 148 0.5592 0.5514 1.2074 0.6560 1.0142 0.3887 18.



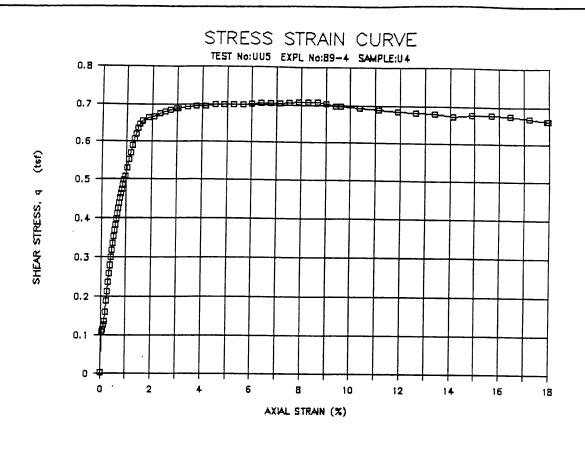


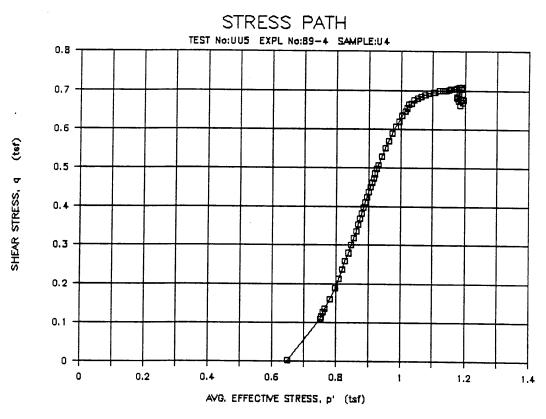
HALEY & ALDRICH, INC. UNCONSOLIDATED UNDRAINED COMPRESSION TEST SUMMARY TEST No. UU4 PROJECT: Roughans Point FILE No. 10259-01 Revere, Massachusetts DATE JAN 1990 SAMPLE DESCRIPTION: Soft gray brown ORGANIC CLAY EXPLORATION No.: B89-4 SAMPLE No.: U2 DEPTH (ft.) 13.0 ATTERBERG LIMITS: WL= 93.8 IP= uP= 28.3 IL= SAMPLE DIMENSIONS: SAMPLE QUALITY DISPLACEMENT RATE (mm/min) 0.0585 PRESHEAR FINAL { }GOOD AXIAL STRAIN RATE (%/hour) 7.443 6.449 3.718 height (cm) { }FAIR 3.580 {x}POOR diameter (cm) area (sq. cm) 10.066 10.857 volume (cc) 74.9211 70.0166 PEAK UNDRAINED TOTAL UNIT SHEAR STRENGTH, WATER CONTENT (%) 88.53 88.34 WEIGHT (pcf): 91.2 cu (tsf): 0.132 AVG. PORE SECANT SHEAR EFFECTIVE TOTAL PORE STRESS PRESS. YOUNG'S **ENTRY** AXIAL STRESS, STRESS, STRESS, PRESSURE, RATIO, PARAM. MODULUS, REMARKS STRAIN No. p' Р q/p' A Ε (%) (tsf) (tsf) (tsf) (tsf) (tsf) 0.000 0.0016 0.0648 0.6664 0.6016 0.0241 0.118 0.0129 2 0.0713 0.6777 0.6064 0.1808 0.2132 3 0.240 0.0210 0.0686 0.6858 0.6172 0.3060 0.4023 17.5 0.358 0.0248 0.0716 0.6897 0.6181 0.3471 0.3550 13.9 5 0.476 0.0305 0.0754 0.6954 0.3182 0.6200 0.4052 12.8 6 0.595 0.0344 0.0769 0.6992 0.6223 0.4468 0.3160 7 0.711 0.0385 0.0794 0.7033 0.6239 0.4849 0.3028 8 0.830 0.0423 0.0812 0.7072 0.6260 0.5212 0.2995 10.2 0.950 9 0.0464 0.0834 0.7112 0.5556 0.6278 0.2922 9.8 10 1.072 0.0496 0.0812 0.7145 0.6332 0.6108 0.3293 11 1.193 0.0529 0.0817 0.7177 0.6360 0.6472 0.3358 8.9 1.354 12 0.0568 0.0858 0.7217 0.6359 0.6626 0.3105 0.0887 13 1.596 0.0612 0.7260 0.6373 0.6896 0.2996 7.7 14 1.829 0.0655 0.0917 0.7304 0.6387 0.7148 0.2902 15 2.068 0.0711 0.0893 0.7359 0.6466 0.7957 0.3238 16 2.549 0.0766 0.6480 0.0934 0.7414 0.8200 0.3096 17 3.235 0.0849 0.0970 0.7497 0.6527 0.8753 0.3071 5.2 18 3.931 0.0940 0.1033 0.7588 0.6555 0.9098 0.2919 19 4.723 0.1017 0.1100 0.7665 0.6565 0.9244 0.2745 4.3 5.520 20 0.1084 0.1156 0.7733 0.6577 0.9379 0.2624 3.9 21 6.310 0.1125 0.1254 0.7773 0.6519 0.8972 0.2271 3.6 22 7.041 0.1127 0.1238 0.7775 0.6538 0.9106 0.2349 3.2 8.596 23 0.1201 0.1333 0.7849 0.6516 0.9005 0.2110 2.8 24 10.187 0.1255 0.1413 0.7903 0.6490 0.8880 0.1915 2.5 11.736 25 0.1406 0.1275 0.7924 0.6518 0.9075 0.1995 26 27 13.348 0.1290 0.1529 0.7939 0.6410 0.8440 0.1547 1.9 14.132 0.1298 0.1525 0.7947 0.6422 0.8513 0.1582 1.8 28 16.501 0.1306 0.1574 0.7955 0.6381 0.8299 0.1414 1.6 29 18.846 0.1311 0.1536 0.7959 0.6423 0.1572 0.8532 1.4 18.969 0.1277 0.1522 0.7926 0.6404 0.8393 0.1538



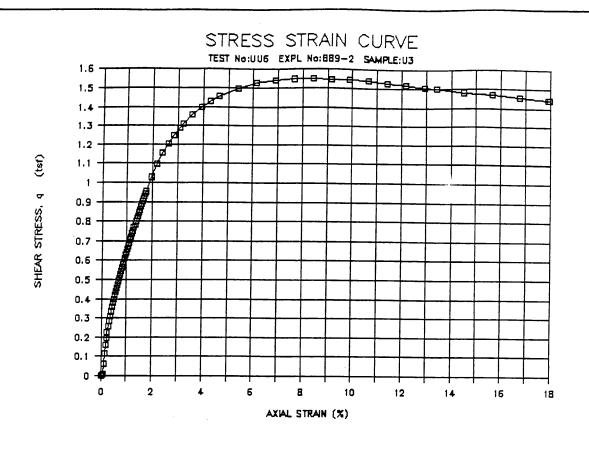


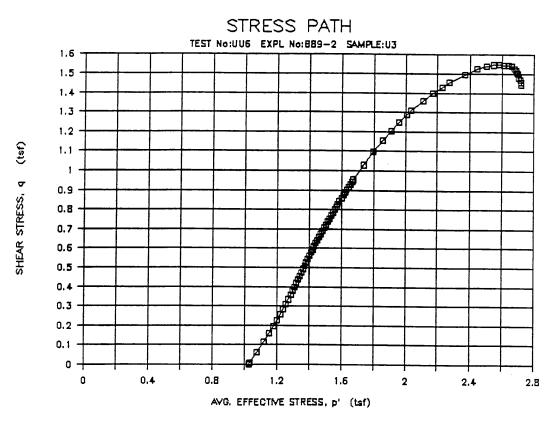
MALET & ALDRI				LIDATED UND						TEST No.	UU5
					• • • • • • • • • • • • • • • • • • • •			• • • • • • • • • • • • • • • • • • • •			• • • • • • • • • • • • • • • • • • • •
PROJECT:	Roughans Revere,	: Point Massachuse	tts							FILE No.	10259-01
	-									DATE	JAN 1990
				SAMPLE DESC	RIPTION:	Stiff gray	green s	ilty CLAY			
EXPLORATION	No.:889-4					with medic	um to fine	sand se	ams		
SAMPLE No.: DEPTH (ft.)				477500500 I	14170						
DEP1H (11.)	34.3			ATTERBERG L		HP= 24.5					
*****	******	******	******	******	******	******	******	*****	*****	******	******
SAMPLE DIMEN	SIONS:			_							
		PRESHEAR	FINAL		AMPLE QU/	KLIIY			EMENT RATE TRAIN RATE		
heig	ht (cm) eter (cm) (sq. cm)	7.920	6.870		{x}FAIR					, /	
area	eter (CM) (SQ. CM)	3.59 9 10.173	4.109 13.261		{ }POOR						
volu	me (cc)	80.5710	91.1001					PEAK UND	DRAINED		
WATER CONTEN	T (%)	37.41	38 27	TOTAL	UNIT	117 4		SHEAR ST	TRENGTH,	0.709	
****	*****	*****	*****	*******	*****	******	******	*****	******	******	******
				AVG.	AVG.			PORE	SECANT		
ENTRY	AXIAL		SHEAR STRESS,	EFFECTIVE STRESS,			STRESS ,RATIO,	PRESS. Param.	YOUNG'S MODULUS,		ENADRE
No.	STRAIN		q	p'	p		q/p'		E	K	EMARKS
	(%)		(tsf)	(tsf)	(tsf)	(tsf)			(tsf)		
1	0.000		0.0015	0.6490	0.7041	0.0551	0.0024				
2 3 4 5 6	0.106		0.1261	0.7614	0.8286	0.0672	0.1656		237.9		
3 4	0.214 0.328		0.1880 0.2589	0.7974 0.8294	0.8905	0.0931 0.1321	0.2358		175.9		
5	0.435		0.3198	0.8551	0.9615 1.0223	0.1321	0.3122 0.3740	0.1496 0.1762	157.7 146.9		
6	0.541		0.3697	0.8744	1.0723	0.1978	0.4228	0.1732	136.6		
7	0.647		0.4119	0.8902	1.1145	0.2243	0.4628	0.2062	127.3		
8	0.752		0.4509	0.9059	1.1535	0.2476	0.4978	0.2142	120.0		
9	0.858		0.4859	0.9209	1.1885	0.2676	0.5277	0.2194	113.3		
10	1.006		0.5290	0.9413	1.2315	0.2902	0.5619	0.2229	105.1		
11 12	1.228		0.5886	0.9739	1.2911	0.3172	0.6043	0.2233	95.9		
13	1.447 1.616		0.6344 0.6555	1.0050	1.3369	0.3319	0.6312				
13	2.291		0.6740	1.0199 1.0424	1.3580 1.3766	0.3381 0.3342	0.6427 0.6466		81.1		
14			0.6888		1.3914		0.6416	0.2075	58.8 46.6		
14 15	2.953				1.3985	0.2970	0.6318	0.1742	36.8		
14 15 16	2.953 3.780		0.6959	1.1015	1.3703						
15			0.6959 0.6987	1.1015 1.1296	1.4012	0.2716	0.6185				
15 16 17 18	3.780 4.886 5.997		0.69 87 0.7015	1.1296 1.1504		0.2716 0.25 36	0.6098	0.1553 0.1418	28.6 23.4		
15 16 17 18 19	3.780 4.886 5.997 7.124		0.6987 0.7015 0.7045	1.1296 1.1504 1.1697	1.4012 1.4040 1.4071	0.2716 0.2536 0.2374	0.6098 0.6023	0.1553 0.1418 0.1297	28.6 23.4 19.8		
15 16 17 18 19 20	3.780 4.886 5.997 7.124 7.888		0.6987 0.7015 0.7045 0.7075	1.1296 1.1504 1.1697 1.1808	1.4012 1.4040 1.4071 1.4101	0.2716 0.2536 0.2374 0.2293	0.6098 0.6023 0.5992	0.1553 0.1418 0.1297 0.1234	28.6 23.4 19.8 17.9		
15 16 17 18 19 20 21	3.780 4.886 5.997 7.124 7.888 8.646		0.6987 0.7015 0.7045 0.7075 0.7087	1.1296 1.1504 1.1697 1.1808 1.1898	1.4012 1.4040 1.4071 1.4101 1.4113	0.2716 0.2536 0.2374 0.2293 0.2215	0.6098 0.6023 0.5992 0.5957	0.1553 0.1418 0.1297 0.1234 0.1177	28.6 23.4 19.8 17.9 16.4		
15 16 17 18 19 20 21	3.780 4.886 5.997 7.124 7.888 8.646 9.404		0.6987 0.7015 0.7045 0.7075 0.7087 0.6976	1.1296 1.1504 1.1697 1.1808 1.1898 1.1826	1.4012 1.4040 1.4071 1.4101 1.4113 1.4002	0.2716 0.2536 0.2374 0.2293 0.2215 0.2176	0.6098 0.6023 0.5992 0.5957 0.5899	0.1553 0.1418 0.1297 0.1234 0.1177 0.1167	28.6 23.4 19.8 17.9 16.4 14.8		
15 16 17 18 19 20 21 22 23	3.780 4.886 5.997 7.124 7.888 8.646 9.404 10.376		0.6987 0.7015 0.7045 0.7075 0.7087 0.6976 0.6917	1.1296 1.1504 1.1697 1.1808 1.1898 1.1826 1.1821	1.4012 1.4040 1.4071 1.4101 1.4113 1.4002 1.3942	0.2716 0.2536 0.2374 0.2293 0.2215 0.2176 0.2121	0.6098 0.6023 0.5992 0.5957 0.5899 0.5851	0.1553 0.1418 0.1297 0.1234 0.1177 0.1167 0.1138	28.6 23.4 19.8 17.9 16.4 14.8 13.3		
15 16 17 18 19 20 21 22 23 24	3.780 4.886 5.997 7.124 7.888 8.646 9.404 10.376 11.895		0.6987 0.7015 0.7045 0.7075 0.7087 0.6976 0.6917 0.6838	1.1296 1.1504 1.1697 1.1808 1.1898 1.1826 1.1821 1.1751	1.4012 1.4040 1.4071 1.4101 1.4113 1.4002 1.3942 1.3863	0.2716 0.2536 0.2374 0.2293 0.2215 0.2176 0.2121 0.2113	0.6098 0.6023 0.5992 0.5957 0.5899 0.5851 0.5819	0.1553 0.1418 0.1297 0.1234 0.1177 0.1167 0.1138 0.1145	28.6 23.4 19.8 17.9 16.4 14.8 13.3		
15 16 17 18 19 20 21 22 23 24 25	3.780 4.886 5.997 7.124 7.888 8.646 9.404 10.376 11.895 13.378		0.6987 0.7015 0.7045 0.7075 0.7087 0.6976 0.6917 0.6838 0.6791	1.1296 1.1504 1.1697 1.1808 1.1898 1.1826 1.1821 1.1751 1.1779	1.4012 1.4040 1.4071 1.4101 1.4113 1.4002 1.3942 1.3863 1.3816	0.2716 0.2536 0.2374 0.2293 0.2215 0.2176 0.2121 0.2113 0.2038	0.6098 0.6023 0.5992 0.5957 0.5899 0.5851 0.5819	0.1553 0.1418 0.1297 0.1234 0.1177 0.1167 0.1138 0.1145 0.1097	28.6 23.4 19.8 17.9 16.4 14.8 13.3 11.5		
15 16 17 18 19 20 21 22 23 24	3.780 4.886 5.997 7.124 7.888 8.646 9.404 10.376 11.895 13.378 14.892		0.6987 0.7015 0.7045 0.7075 0.7087 0.6976 0.6917 0.6838 0.6791 0.6771	1.1296 1.1504 1.1697 1.1808 1.1828 1.1826 1.1821 1.1751 1.1779 1.1881	1.4012 1.4040 1.4071 1.4101 1.4113 1.4002 1.3942 1.3863 1.3816 1.3796	0.2716 0.2536 0.2374 0.2293 0.2215 0.2176 0.2121 0.2113 0.2038 0.1915	0.6098 0.6023 0.5992 0.5957 0.5899 0.5851 0.5819 0.5765 0.5698	0.1553 0.1418 0.1297 0.1234 0.1177 0.1167 0.1138 0.1145 0.1097 0.1010	28.6 23.4 19.8 17.9 16.4 14.8 13.3 11.5 10.2 9.1		
15 16 17 18 19 20 21 22 23 24 25 26	3.780 4.886 5.997 7.124 7.888 8.646 9.404 10.376 11.895 13.378		0.6987 0.7015 0.7045 0.7075 0.7087 0.6976 0.6917 0.6838 0.6791	1.1296 1.1504 1.1697 1.1808 1.1898 1.1826 1.1821 1.1751 1.1779	1.4012 1.4040 1.4071 1.4101 1.4113 1.4002 1.3942 1.3863 1.3816	0.2716 0.2536 0.2374 0.2293 0.2215 0.2176 0.2121 0.2113 0.2038	0.6098 0.6023 0.5992 0.5957 0.5899 0.5851 0.5819	0.1553 0.1418 0.1297 0.1234 0.1177 0.1167 0.1138 0.1145 0.1097	28.6 23.4 19.8 17.9 16.4 14.8 13.3 11.5		



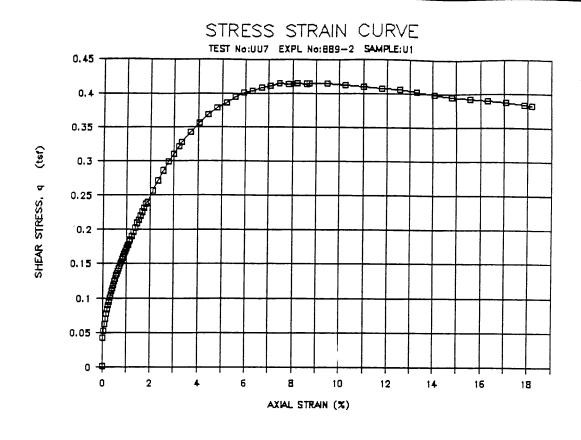


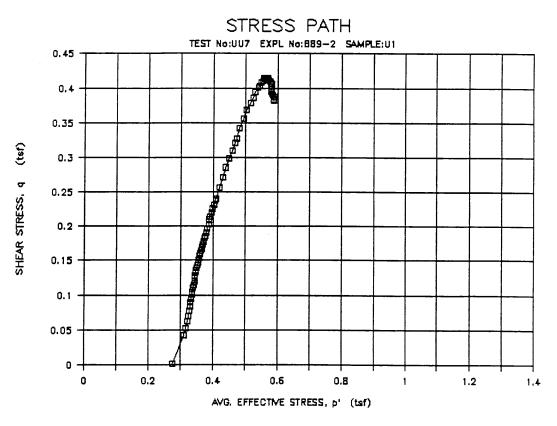
HALEY & ALD	RICH, INC.							ARY		TEST No.	UU6
	• • • • • • • • • • • • • • • • • • • •										
PROJECT:	Roughans									FILE No.	10259-01
	Kevere,	Massachuset	tts							DATE	Feb. 1990
				CAMDIE DECC	DIDIIONA	Chilf	:				100. 1770
				SAMPLE DESC	KIPIIUN:	Stiff gray	green si	ILTY CLAY			
EXPLORATION SAMPLE NO.:											
DEPTH (ft.)	35.8			ATTERBERG L							
					!	⊮P= 17.5	IL=	0.5			
*****	******	*****	******	******	******	******	*****	******	******	*****	******
SAMPLE DIME		•									
SAMPLE DIME	.NOIONOI				AMPLE QUA	LITY		DISPLACE	MENT RATE	(mm/min)	0.0596
hei	ght (cm)	PRESHEAR 7.947	FINAL		(x)GOOD {)FAIR			AXIAL ST	RAIN RATE	(%/hour)	4.50
	meter (cm)	3.635	4.032		()POOR						
are	ea (sq. cm) ume (cc)	10.378 82.4711	12.768					DEAK IND			
	- •			TOTAL	UNIT			PEAK UND SHEAR ST	DENCTH		
WATER CONTE	NT (%)	28.98	29.40	WEIGH	T (pcf):	125.0		cu (tsf)	:	1.548	
******	*****	*****	******	*****	*****	******	*****	*****	*****	*****	******
,			01/548	AVG.	AVG.			PORE	SECANT		
ENTRY	AXIAL		SHEAR STRESS,			PORE PRESSURE			YOUNG'S MODULUS,		EMARKS
No.	STRAIN		q	P'	P	u	q/p'		E	"	LIMINO
	(%)	•	(tsf)	(tsf)	(tsf)	(tsf)			(tsf)		
1	0.000		0.0015	1.0264	1.0625	0.0361	0.0015				
2 3 4 5	0.105		0.0627	1.0767	1.1236	0.0469	0.0582	0.0884	119.6		
4	0.205 0.308		0.1954 0.2830	1.1807 1.2413	1.2564 1.3440	0.0757 0.1028	0.1655 0.2280		190.4 183.6		
5	0.412		0.3576	1.2864	1.4186	0.1321	0.2780	0.1348	173.5		
6	0.520		0.4199	1.3220	1.4809	0.1588	0.3176	0.1467			
7	0.626		0.4759	1.3535	1.5369	0.1834	0.3516	0.1552	152.0		
8 9	0. <i>7</i> 31 0.843		0.5277 0.5785	1.3826 1.4123	1.5886 1.6395	0.2060 0.2271	0.3816	0.1615	144.4		
10	0.953		0.6275	1.4416	1.6884	0.2469	0.4096 0.4353	0.1655 0.1683	137.3 131.7		
11	1.059		0.6751		1.7360	0.2647	0.4588				
12	1.167		0.7223		1.7832	0.2808	0.4807	0.1698	123.7		
13	1.276		0.7696		1.8306	0.2963		0.1694	120.7		
14 15	1.385 1.495		0.8151	1.5664 1.5991	1.8761	0.3097	0.5204	0.1681	117.7		
16	1.603		0.9027	1.6320	1.9204 1.9636	0.3214 0.3317	0.5531	0.1640	112.6		
17	1.713		0.9448	1.6655	2.0058	0.3403	0.5673	0.1613	110.3		
18	2.173		1.0968	1.7973	2.1578	0.3606	0.6103	0.1481	100.9		
19	2.834		1.2489	1.9590	2.3099	0.3509	0.6375	0.1262	88.1		
20 21	3.194 3.930		1.3090 1.3968	2.0355	2.3700	0.3345	0.6431	0.1141	82.0		
22	4.649		1.4550	2.1687 2.2746	2.4578 2.5160	0.2891 0.2414	0.6441 0.6397	0.0907 0.0706	71.1 62.6		
23	6.138		1.5264	2.4448	2.5873	0.1426	0.6243	0.0349	49.7		
24	7.658		1.5466	2.5463	2.6076	0.0613	0.6074	0.0081	40.4		
25	9.150		1.5444	2.6127	2.6054	-0.0073	0.5911	-0.0141	33.8		
	10.638 11.397		1.5385 1.5273	2.6605 2.6747	2.5995 2.5883	-0.0611	0.5783 0.5710	-0.0316	28.9		
26 27	11.37/		1.34/3	Z.0/4/	دەەد. ،	-0.0864	U.3/10	-0.0401	26.8		
27											
	13.412 16.770		1.4992 1.4575	2.7002 2.7209	2.5602 2.5185	-0.1400 -0.2024	0.5552 0.5357	-0.0588 -0.0819	22.4 17.4		



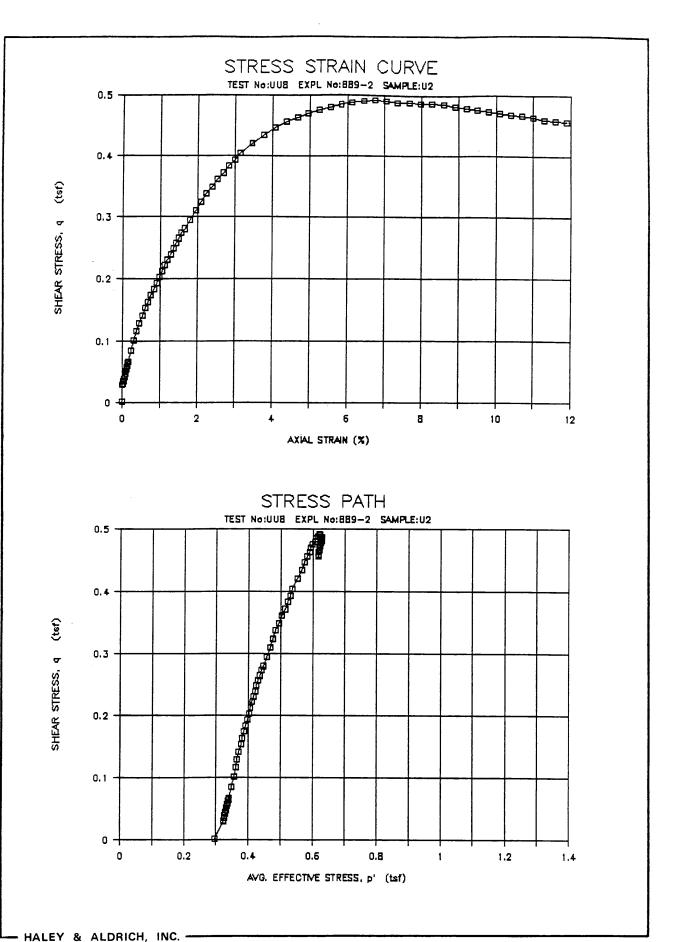


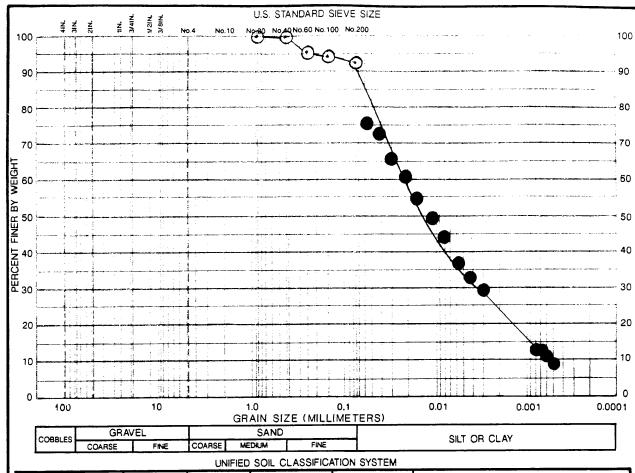
HALEY & ALDRI				IDATED UNDR							UU7
PROJECT:			• • • • • • • • •		*********			•			10259-01
	Revere,	Massachuset	tts								
									'	DATE	Feb. 1990
				SAMPLE DESC		Gray green ORGANIC CL		tiff			
EXPLORATION											
SAMPLE No.: DEPTH (ft.)	23.75			ATTERBERG L	IMITS: w	L= 94.4	IP=	60.4			
					W	P= 34.0	IL=	0.4			
*****	*****	*****	******	*****	******	*****	*****	*****	******	*****	*****
SAMPLE DIMEN	ISIONS:			_							
		PRESHEAR	FINAL	S	AMPLE QUA {x}GOOD	LITY			MENT RATE		
heig	iht (cm)	7.909	6.994					WINE 31	KAIN KAIE	(A/Hour)	4.54
diam	neter (cm)	3.583	3.811		{ }FAIR { }POOR						
area	ht (cm) neter (cm) n (sq. cm) nme (cc)	10.083 70 7453	11.407 70.7700					PEAK UND	PATNED		
				TOTAL	UNIT			SHEAR ST	RENGTH.		
WATER CONTEN	IT (%)	60.25	58.27	WEIGH	T (pcf):	103.8		cu (tsf)	:	0.415	
*****	*****	*****	*****	******	*****	*****	*****	*****	*****	*****	******
			CHEAD	AVG.		DODE	CTRECC	PORE	SECANT		
ENTRY	AXIAL		SHEAR STRESS.	EFFECTIVE	TOTAL			PRESS.	YOUNG'S	R	EMARKS
ENTRY No.	AXIAL STRAIN		STRESS,	EFFECTIVE STRESS, p'	TOTAL STRESS, P	PRESSURE U	,RATIO, q/p'	PRESS. PARAM.	YOUNG'S MODULUS, E	R	EMARKS
			STRESS,	EFFECTIVE STRESS,	TOTAL STRESS, P	PRESSURE	,RATIO, q/p'	PRESS. PARAM.	YOUNG'S MODULUS,	R	EMARKS
	STRAIN		STRESS,	EFFECTIVE STRESS, p'	TOTAL STRESS, P	PRESSURE U	,RATIO, q/p'	PRESS. PARAM.	YOUNG'S MODULUS, E	R	EMARKS
No. 1 2	STRAIN (%) 0.000 0.099		STRESS, q (tsf) 0.0016 0.0621	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590	TOTAL STRESS, p (tsf) 0.6711 0.7317	PRESSURE u (tsf) 0.4560 0.4726	,RATIO, q/p' 0.0073 0.2398	PRESS. PARAM. A	YOUNG'S MODULUS, E (tsf)	R	EMARKS
No. 1 2 3	STRAIN (%) 0.000 0.099 0.203		9 (tsf) 0.0016 0.0621 0.0840	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536	PRESSURE U (tsf) 0.4560 0.4726 0.4859	,RATIO, q/p' 0.0073 0.2398 0.3138	PRESS. PARAM. A 0.1376 0.1813	YOUNG'S MODULUS, E (tsf) 125.2 82.9	R	EMARKS
No. 1 2 3 4	STRAIN (%) 0.000 0.099 0.203 0.311		9 (tsf) 0.0016 0.0621 0.0840 0.1008	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703	PRESSURE u (tsf) 0.4560 0.4726 0.4859 0.4968	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684	PRESS. PARAM. A 0.1376 0.1813 0.2058	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9	R	EMARKS
No. 1 2 3 4 5	STRAIN (%) 0.000 0.099 0.203		9 (tsf) 0.0016 0.0621 0.0840	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536	PRESSURE U (tsf) 0.4560 0.4726 0.4859	,RATIO, q/p' 0.0073 0.2398 0.3138	PRESS. PARAM. A 0.1376 0.1813 0.2058	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5	R	EMARKS
No. 1 2 3 4 5 6 7	0.000 0.099 0.203 0.311 0.419 0.526 0.638		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881	TOTAL STRESS, p (tsf) 0.6711 0.7536 0.7736 0.7703 0.7839 0.7977 0.8091	PRESSURE u (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8	R	EMARKS
No. 1 2 3 4 5 6 7 8	\$TRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745		O.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881 0.2937	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197	PRESSURE (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3	R	EMARKS
No. 1 2 3 4 5 6 7 8	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854		O.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881 0.2937 0.2987	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5307	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358 0.2361	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4	R	EMARKS
No. 1 2 3 4 5 6 7 8 9	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966		O.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881 0.2937 0.2987 0.3044	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8395	PRESSURE (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5357 0.5351	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358 0.23581 0.2349	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2	R	EMARKS
No. 1 2 3 4 5 6 7 8	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854		O.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881 0.2937 0.2987	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8395 0.8482	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5307	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582 0.5770	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2355 0.2358 0.2361 0.2349 0.2335	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2881 0.2937 0.2987 0.3044 0.3095 0.3166 0.3262	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8395 0.8482 0.8604 0.8794	PRESSURE (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5386 0.5437 0.5533	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582 0.5770 0.6026 0.6435	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2361 0.2349 0.2335 0.2318	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13	\$TRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658		O.0016 0.0621 0.0840 0.1008 0.1144 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8395 0.8482 0.8604 0.8794 0.8955	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5386 0.5437 0.5533 0.5585	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582 0.5770 0.6026 0.60435 0.6704	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2361 0.2349 0.2335 0.2318 0.2335 0.2318	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 31.3 29.3 27.2	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872		O.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8395 0.8482 0.8604 0.8794 0.8955 0.9102	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5210 0.5260 0.5337 0.5386 0.5437 0.5533 0.5585 0.5633	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5770 0.6026 0.6026 0.6704 0.6937	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358 0.2361 0.2349 0.2335 0.2335 0.2335 0.2284	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 31.3 29.3 27.2 25.7	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7977 0.8091 0.8197 0.8295 0.8395 0.8482 0.8604 0.8794 0.8794 0.9552	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5386 0.5433 0.5777	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2355 0.2361 0.2349 0.2335 0.2318 0.2335 0.2284 0.2284 0.2285	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 31.3 29.3 27.2 25.7 22.5	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872		O.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2785 0.2823 0.2881 0.2937 0.3987 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.4056	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 0.9905	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5307 0.5351 0.5386 0.5437 0.5585 0.5633 0.5777 0.5849	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5770 0.6026 0.6026 0.6704 0.6937	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2361 0.2349 0.2335 0.2318 0.2335 0.2284 0.2245 0.2143 0.2019	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 29.3 27.2 25.7 22.5 20.1	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1699 0.2259 0.2259 0.2259 0.2406 0.2856 0.3210 0.3557 0.3861	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2881 0.2937 0.2987 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4333 0.4619	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 0.9552	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5307 0.5351 0.5386 0.5437 0.5533 0.5777 0.5849 0.5919 0.5938	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.5114 0.5354 0.5582 0.5770 0.6026 0.6026 0.6435 0.6704 0.6937 0.7566 0.7563	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2355 0.2358 0.2335 0.2349 0.2335 0.2284 0.2245 0.2143 0.2019 0.1792	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 64.5 48.7 43.8 40.3 37.4 35.2 33.3 29.3 27.2 25.7 22.5 20.1 17.6 15.0	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.3856 0.3210 0.3557 0.3861 0.4004	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4778	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 0.905 1.0252 1.0557 1.0700	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5386 0.5437 0.5583 0.5777 0.5849 0.5919 0.5938 0.5922	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5582 0.5770 0.6026 0.60435 0.6704 0.6937 0.7566 0.7913 0.8360 0.8380	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2351 0.2349 0.2335 0.2318 0.2335 0.2284 0.2245 0.2143 0.2019 0.1920 0.1792 0.1792	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 27.2 25.7 22.5 20.1 17.6 15.0 13.5	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856 0.3210 0.3557 0.3861 0.4004 0.4089	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2823 0.2823 0.2827 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4333 0.4619 0.4778	TOTAL STRESS, P (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 1.0252 1.0557 1.0700 1.0784	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5210 0.5260 0.5337 0.5351 0.5386 0.5437 0.5585 0.5633 0.5777 0.5849 0.5919 0.5938 0.5922 0.5905	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566 0.7913 0.8208 0.8380 0.8380	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358 0.2361 0.2349 0.2335 0.2335 0.2384 0.2245 0.2143 0.2019 0.1792 0.1792 0.1797 0.1652	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 31.3 29.3 27.2 25.7 22.5 20.1 17.6 15.0 13.5 12.2	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679 7.438		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856 0.3210 0.3557 0.3861 0.4004 0.4089 0.4140	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2785 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.4566 0.4333 0.4619 0.4778 0.4879 0.4963	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 0.9905 1.0252 1.0557 1.0700 1.0784 1.0836	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5533 0.5585 0.5633 0.5777 0.5849 0.5919 0.5938 0.5922 0.5905 0.5873	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566 0.7913 0.8208 0.8360 0.8380 0.8380	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358 0.2361 0.2349 0.2335 0.2318 0.2335 0.2284 0.2245 0.2143 0.2019 0.1920 0.1792 0.1792 0.1792 0.1792 0.1792 0.1592	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 27.2 25.7 22.5 20.1 17.6 15.0 13.5 12.2 11.1	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679 7.438 8.195		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1599 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856 0.35210 0.3557 0.3861 0.4004 0.4089 0.4140	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2785 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4333 0.4619 0.4778 0.4879 0.4963	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 0.9552 1.0252 1.0557 1.0700 1.0784 1.0836 1.0844	PRESSURE (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5307 0.5351 0.5386 0.5437 0.5533 0.5777 0.5849 0.5919 0.5938 0.5922 0.5905	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566 0.7913 0.8208 0.8360 0.8380 0.8380 0.8383	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2361 0.2349 0.2335 0.2318 0.2335 0.2284 0.2245 0.2143 0.2019 0.1792 0.1792 0.1792 0.1792 0.1592 0.1592	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 25.7 22.5 20.1 17.6 15.0 13.5 12.2 11.1 10.1	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679 7.438 8.195 8.701 10.240		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1699 0.2259 0.22606 0.2856 0.3210 0.3557 0.3861 0.4004 0.4089 0.4140 0.4148 0.4148	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2881 0.2937 0.3987 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4778 0.4778 0.4879 0.4963 0.5040 0.5091	TOTAL STRESS, P (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8482 0.8604 0.8794 0.8955 0.9102 0.9552 1.0557 1.0700 1.0784 1.0836 1.0839 1.0822	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5351 0.5386 0.5437 0.5533 0.5777 0.5849 0.5919 0.5938 0.5922 0.5905 0.5873 0.5873 0.5873 0.5879	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.5114 0.5354 0.5582 0.5770 0.6026 0.6704 0.6937 0.7566 0.77913 0.8208 0.8380 0.8380 0.8380 0.8380 0.8380 0.83822 0.8105	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2356 0.2349 0.2335 0.2284 0.2245 0.2143 0.2019 0.1792 0.1707 0.1652 0.1592 0.1592 0.1592 0.1592 0.1592 0.1592	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 25.7 22.5 7 22.5 11.1 10.1 9.5 8.1	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679 7.438 8.195 8.701 10.240 11.774		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856 0.3210 0.3557 0.3861 0.4004 0.4089 0.4140 0.4148 0.4143 0.4126 0.4075	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4778 0.4633 0.4778 0.4879 0.4963 0.5020 0.5091 0.5091	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8492 0.8482 0.8794 0.8794 0.8955 1.0557 1.0700 1.0784 1.0836 1.0844 1.0839 1.0822 1.0771	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5386 0.5437 0.5583 0.5777 0.5849 0.5919 0.5938 0.5922 0.5905 0.5873 0.5824 0.5799 0.5731 0.5604	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566 0.7913 0.8263 0.8380 0.8380 0.8380 0.8383 0.8263 0.8380 0.8383	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2351 0.2349 0.2335 0.2218 0.2245 0.2143 0.2019 0.1920 0.1792 0.1707 0.1652 0.1592 0.1592 0.1592 0.1592 0.1592 0.1592	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 27.2 25.7 22.5 20.1 17.6 15.0 13.5 12.2 11.1 10.1 9.5 8.1 6.9	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679 7.438 8.195 8.701 10.240 11.774 12.547		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856 0.3210 0.3557 0.3861 0.4004 0.4089 0.4143 0.4143 0.4148 0.4143 0.4126 0.4075	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2785 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4333 0.4619 0.4778 0.4963 0.4963 0.5020 0.5040 0.5091 0.5167 0.5196	TOTAL STRESS, P (tsf) 0.6711 0.7317 0.7536 0.7703 0.7977 0.8091 0.8197 0.8295 0.8395 0.8482 0.8604 0.8794 0.8795 1.0252 1.0557 1.0752 1.0752 1.0836 1.0844 1.0839 1.0842 1.0771 1.0748	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5210 0.5260 0.5337 0.5385 0.5437 0.5585 0.5633 0.5777 0.5849 0.5919 0.5905 0.5873 0.5824 0.5799 0.57731 0.5604 0.5551	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.55582 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566 0.7913 0.8208 0.8380 0.8380 0.8383 0.8263 0.8263 0.8263 0.7798	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2346 0.2355 0.2358 0.23318 0.2335 0.2284 0.2245 0.2143 0.2019 0.1920 0.1792 0.1792 0.1792 0.1502 0.1529 0.1529 0.1529 0.1528	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 27.2 25.7 22.5 720.1 17.6 15.0 13.5 12.2 11.1 10.1 9.5 8.1 6.9 6.5	R	EMARKS
No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	STRAIN (%) 0.000 0.099 0.203 0.311 0.419 0.526 0.638 0.745 0.854 0.966 1.073 1.219 1.435 1.658 1.872 2.537 3.197 4.046 5.163 5.913 6.679 7.438 8.195 8.701 10.240 11.774		STRESS, q (tsf) 0.0016 0.0621 0.0840 0.1008 0.1144 0.1282 0.1395 0.1502 0.1599 0.1699 0.1786 0.1908 0.2099 0.2259 0.2406 0.2856 0.3210 0.3557 0.3861 0.4004 0.4089 0.4140 0.4148 0.4143 0.4126 0.4075	EFFECTIVE STRESS, p' (tsf) 0.2152 0.2590 0.2677 0.2735 0.2823 0.2881 0.2937 0.3044 0.3095 0.3166 0.3262 0.3370 0.3469 0.3775 0.4056 0.4778 0.4633 0.4778 0.4879 0.4963 0.5020 0.5091 0.5091	TOTAL STRESS, p (tsf) 0.6711 0.7317 0.7536 0.7703 0.7839 0.7977 0.8091 0.8197 0.8295 0.8492 0.8482 0.8794 0.8794 0.8955 1.0557 1.0700 1.0784 1.0836 1.0844 1.0839 1.0822 1.0771	PRESSURE U (tsf) 0.4560 0.4726 0.4859 0.4968 0.5054 0.5154 0.5210 0.5260 0.5337 0.5386 0.5437 0.5583 0.5777 0.5849 0.5919 0.5938 0.5922 0.5905 0.5873 0.5824 0.5799 0.5731 0.5604	,RATIO, q/p' 0.0073 0.2398 0.3138 0.3684 0.4107 0.4539 0.4843 0.5114 0.5354 0.5582 0.5770 0.6026 0.6435 0.6704 0.6937 0.7566 0.7913 0.8263 0.8380 0.8380 0.8380 0.8383 0.8263 0.8380 0.8383	PRESS. PARAM. A 0.1376 0.1813 0.2058 0.2194 0.2355 0.2358 0.2351 0.2349 0.2335 0.2218 0.2245 0.2143 0.2019 0.1920 0.1792 0.1707 0.1652 0.1592 0.1592 0.1592 0.1592 0.1592 0.1592	YOUNG'S MODULUS, E (tsf) 125.2 82.9 64.9 54.5 48.7 43.8 40.3 37.4 35.2 33.3 27.2 25.7 22.5 20.1 17.6 15.0 13.5 12.2 11.1 10.1 9.5 8.1 6.9	R	EMARKS





				LIDATED UNDR							uu 8
PROJECT:	Roughans	Point									10259-01
	Revere,	Massachuset	ts							DATE	Feb. 1990
				SAMPLE DESC)ro w n	,	DA1 E	165. 1770
EXPLORATION					(ORGANIC CL	AY				
SAMPLE No.: DEPTH (ft.)	U2 13.8			ATTERBERG L	.IMITS: W	L= 96.1	IP=	64.0			
• • • • • • • • • • • • • • • • • • • •				ATTERBERG L	W	P= 32.1	IL=	0.5			
******	*****	******	*****	******	*****	******	******	*****	******	*****	*****
SAMPLE DIMEN	SIONS:			s	AMPLE QUA	i iTY		DISPLACE	MENT RATE	(mm/min)	0 0602
		PRESHEAR	FINAL		{x}G000			AXIAL ST	RAIN RATE	(mm/min) (%/hour)	4.55
heig	ht (cm)	7.930 3.500	6.915		{ }FAIR { }POOR						
area	ht (cm) eter (cm) (sq. cm)	10.122	11.708		CAPOUR						
VALU	TA (^^)	XII JAUX	XII UAZI		LIMITT			PEAK UND	RAINED		
WATER CONTEN	T (%)	61.31	60.31	WEIGH	UNII T (pcf):	101.5		CU (tsf)	RENGTH,	0.493	
		•									*****
			*******								*******
			CUEAD	AVG.	AVG.	PORE	CTRECC	PORE	SECANT		
ENTRY	AXIAL		SHEAR STRESS,	STRESS,	STRESS,	PRESSURE	,RATIO,	PARAM.	MODULUS,	ş	REMARKS
No.	STRAIN		a	p'	p	u	q/p'	A	E		
	(%)		(tsf)	(tsf)	(tst)	(tsf)			(tsf)		
1	0.000		0.0016	0.2504	0.8911						
2	0.035		0.0341	0.2793 0.2810	0.9236 0.9286		0.1223 0.1393		196.7 134.7		
3	0.058 0.087		0.0392		0.9344		0.1587		103.6		
4				0.2861	0.9410	0.6549	0.1801	0.1426	92.8		
4 5			0.0515								
4 5 6	0.111 0.135		0.0515 0.0586	0.2896	0.9481	0.6586	0.2025	0.1571	87.2		
5	0.111		0.0586 0.0644	0.2920	0.9539	0.6619	0.2206	0.1690	83.4		
5 6 7 8	0.111 0.135 0:154 0.315		0.0586 0.0644 0.1012	0.2920 0.3085	0.9539 0.9907	0.6619 0.6822	0.2206 0.3282	0.1690 0.2086	83.4 64.3		
5 6 7 8 9	0.111 0.135 0.154 0.315 0.533		0.0586 0.0644 0.1012 0.1409	0.2920 0.3085 0.3239	0.9539 0.9907 1.0304	0.6619 0.6822 0.7065	0.2206 0.3282 0.4351	0.1690 0.2086 0.2364	83.4 64.3 52.9		
5 6 7 8 9	0.111 0.135 0.154 0.315 0.533 0.756		0.0586 0.0644 0.1012 0.1409	0.2920 0.3085 0.3239	0.9539 0.9907 1.0304 1.0636	0.6619 0.6822 0.7065 0.7238	0.2206 0.3282 0.4351 0.5124	0.1690 0.2086 0.2364 0.2410	83.4 64.3 52.9 46.1		
5 6 7 8 9 10	0.111 0.135 0.154 0.315 0.533 0.756 0.975		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040	0.2920 0.3085 0.3239 0.3398 0.3547	0.9539 0.9907 1.0304 1.0636 1.0935	0.6619 0.6822 0.7065 0.7238 0.7388	0.2206 0.3282 0.4351 0.5124 0.5751	0.1690 0.2086 0.2364 0.2410 0.2425	83.4 64.3 52.9 46.1 41.8		
5 6 7 8 9 10 11	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040	0.2920 0.3085 0.3239 0.3398 0.3547	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416	83.4 64.3 52.9 46.1 41.8 38.4		
5 6 7 8 9 10 11 12	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568	0.2920 0.3085 0.3239 0.3398 0.3547	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416	83.4 64.3 52.9 46.1 41.8 38.4 36.1		
5 6 7 8 9 10 11 12 13	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0		
5 6 7 8 9 10 11 12	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800	0.2920 0.3085 0.3239 0.3398 0.3547	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217	83.4 64.3 52.9 46.1 41.8 38.4 36.1		
5 6 7 8 9 10 11 12 13 14	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3		
5 6 7 8 9 10 11 12 13 14 15 16 17 18	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825 1.3242	0.6619 0.6822 0.7065 0.7238 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825 1.3242 1.3529	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 219.9		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825 1.3529 1.3648	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8136	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8624	0.1690 0.2086 0.2364 0.2410 0.2425 0.2411 0.2343 0.2217 0.2135 0.2030 0.1851 0.1826	83.4 64.3 52.9 46.1 41.8 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5512 0.5610	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825 1.3242 1.3529 1.3648 1.3743	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.86561 0.8624 0.8641	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1826	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4848	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512 0.5610	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.3529 1.3529 1.3548 1.3743 1.3822	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.8069 0.8116 0.8133 0.8133	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8624 0.8641 0.8598	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1826 0.1715	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743 7.668		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4848	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512 0.5610 0.5730	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825 1.3529 1.3648 1.3773 1.3822 1.3777	0.6619 0.6822 0.7065 0.7238 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133 0.8133 0.8092	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8564 0.8564	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1826 0.1715 0.1667	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6 14.6		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743 7.668 9.205		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4848 0.4927 0.4882	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512 0.5610 0.5730 0.5748	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2825 1.3242 1.3529 1.3648 1.3743 1.3822 1.3777	0.6619 0.6822 0.7065 0.7258 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133 0.8029 0.8029 0.7898	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8624 0.8641 0.8649 0.8494 0.8275	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1786 0.1786 0.1775 0.1667	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6 14.6 12.7		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743 7.668 9.205 10.684		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4848 0.47927 0.4882 0.4782	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512 0.5610 0.5730 0.5778	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.3825 1.3529 1.3648 1.3743 1.3822 1.3777 1.3677	0.6619 0.6822 0.7065 0.7238 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133 0.8133 0.8092	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8564 0.8564	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1766 0.1715 0.1667 0.1565 0.1527	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6 14.6		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743 7.668 9.205 10.684 12.210		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4848 0.4927 0.4882 0.4782	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512 0.5610 0.5730 0.5748	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.3825 1.3529 1.3648 1.3743 1.3822 1.3777 1.3553 1.3438	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133 0.8092 0.8029 0.7898 0.7825	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8624 0.8641 0.8598 0.8494 0.8275 0.8131	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1786 0.1786 0.1775 0.1667	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6 14.6 12.7		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743 7.668 9.205 10.684		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4882 0.4782 0.4658	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4829 0.5172 0.5413 0.5512 0.5610 0.5730 0.5778 0.5778	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.3529 1.3648 1.3777 1.3677 1.3553 1.3438 1.3438 1.3438 1.3438	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133 0.8029 0.7898 0.7825 0.7745	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.6712 0.7028 0.7531 0.7903 0.8138 0.8404 0.8561 0.8624 0.8641 0.8598 0.8491 0.8275 0.8131	0.1690 0.2086 0.2364 0.2410 0.2425 0.2416 0.2411 0.2343 0.2217 0.2135 0.2030 0.1920 0.1851 0.1826 0.1715 0.1667 0.1555 0.1527 0.1479	83.4 64.3 52.9 46.1 41.8 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6 14.6 12.7 10.4 8.7 7.4		
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	0.111 0.135 0.154 0.315 0.533 0.756 0.975 1.200 1.421 1.646 2.092 2.537 2.991 3.751 4.655 5.241 5.832 6.743 7.668 9.205 10.684 12.210 13.750		0.0586 0.0644 0.1012 0.1409 0.1741 0.2040 0.2305 0.2568 0.2800 0.3235 0.3604 0.3930 0.4347 0.4634 0.4753 0.4882 0.4782 0.4782	0.2920 0.3085 0.3239 0.3398 0.3547 0.3688 0.3826 0.3984 0.4296 0.4560 0.4560 0.5172 0.5610 0.5730 0.5748 0.5778 0.5728	0.9539 0.9907 1.0304 1.0636 1.0935 1.1200 1.1463 1.1695 1.2130 1.2499 1.2825 1.3529 1.3648 1.3743 1.3822 1.3777 1.3653 1.3438 1.3438	0.6619 0.6822 0.7065 0.7238 0.7388 0.7513 0.7637 0.7711 0.7834 0.7939 0.7996 0.8069 0.8116 0.8133 0.8092 0.8029 0.7898 0.7898 0.7898	0.2206 0.3282 0.4351 0.5124 0.5751 0.6252 0.7728 0.7531 0.7903 0.8138 0.8404 0.8561 0.8624 0.8641 0.8598 0.8494 0.8275 0.8131 0.7980	0.1690 0.2086 0.2364 0.2410 0.2425 0.2411 0.2343 0.2217 0.2135 0.2030 0.1826 0.1715 0.1667 0.1565 0.1565 0.1547 0.1445	83.4 64.3 52.9 46.1 41.8 38.4 36.1 34.0 30.9 28.4 26.3 23.2 19.9 18.1 16.6 14.6 12.7		





UNIFIED	SOIL	CLASSIF	ICATION	SYSTEM

SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
0	в89-2	U1	22.3- 24.3	\$		Medium stiff to stiff gray green ORGANIC CLAY, trace fine sand
		To the second of			AND THE PROPERTY OF THE PROPER	
		· · · · · · · · · · · · · · · · · · ·				

SYMBOL	EXPL. NO.	SAMPLE NO.	Cu	Сс	NATURAL WATER CONTENT(%)		BERG LIN	MITS (%)	L O I (% by wgt.)	G
0	B89-2	U1	40.7	1.03	56.2	94.4	34.0	60.4	5.1	2.62
	· 								- 00 // / / 00 -	



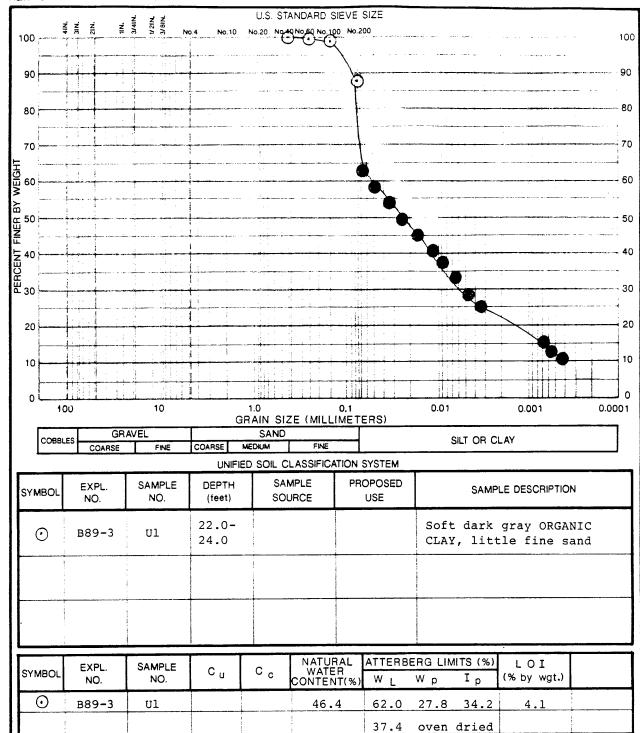
Haley & Aldrich, Inc. Consulting Geotechnical Engineers, Geologists and Hydrogeologists

Roughans Point Revere, Massachusetts

GRAIN SIZE DISTRIBUTION

FILE NO. 10259-01

DATE: Feb. 1990





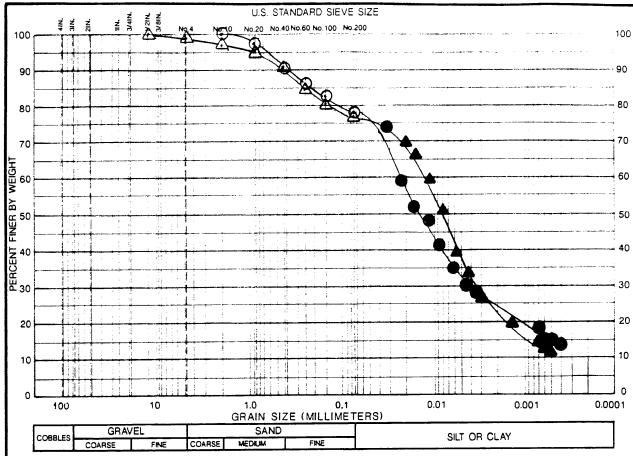
Haley & Aldrich, Inc.

Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ROUGHANS POINT
REVERE, MASSACHUSETTS
GRAIN SIZE DISTRIBUTION

FILE NO. 10259-01

DATE: Feb. 1990



DIVINED SOIL CLASSII IOANON STOTE	UNIFIED SOIL	CLASSIFICATIO	IN SYSTEM
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SYMBOL	EXPL. NO.	SAMPLE NO.	DEPTH (feet)	SAMPLE SOURCE	PROPOSED USE	SAMPLE DESCRIPTION
0	в89-4		22.0- 24.0			Soft to medium stiff, dark brown PEAT
Δ	TP89-5	Block 1				Stiff dark brown PEAT
				Andrew Company	The same of the sa	

	EXPL.	SAMPLE		C		ATTERBERG LIMITS (%)	LOI	G
SYMBOL	NO.	NO.	Cu	Co	WATER CONTENT(%)	W _L W _p I _p	(% by wgt.)	
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Δ	TP89-5	Block 1			147.0	186.5 113.2 73.3	24.4	2.34
					TOTAL TANANCIAN		and the second s	



Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

ROUGHANS POINT

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GRAIN SIZE DISTRIBUTION

FILE NO. 10259-01

DATE: Feb. 1990

APPENDIX D
Chain of Custody Logs

ASA

Geologists and Hydrogeologists

58 Charles Street Cambridge, MA 02141 617/494-1606

Letter of Transmittal

To USACE Materials Laboratory	Date	4 January 1990
424 Trapelo Road		10259.01
No/thom, MA 02254-9149	Subject	Roughons Point
Attention Mr. Mike Corrol		Refere, MA

Copies	Date	Description
leach	1/4/90	Test Pit Bag and Sat Samples
		TP89-1 Jor Samples SI, SIA, SZ, SZA, S3, S3A, SY, SYA
		Bag Sample 51
		TP89-2 Jar Samples SI, S/A, S2, S2A, S3, S3A, S4, S4A
		Bag Sample 51
		TP89-3 Jor Samples 51,51A, 52,52A,53,53A
		Bug Sample SI

Samples to be delivered by Sallivan Express, courier service.

Copy to Mr. Paul Schimelfonyg (letter only)

Signed Thomas W. Beline, III

Branch Offices Glastonbury, Connecticut Portland, Maine Bedford, New Hampshire

Affiliate H & A of New York Rochester, New York

	Haley & Aldrich, Inc.	Aldrich, Inc.		CHAIN	OF C	OF CUSTODY RECORD	² λα(RECO	A O	.:=#		~ ^ \	
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Thomas W. Peline, IN

Consorting
Geofechnical orgineers,
Geofechists and
Hydrogeologists

58 Charles Street Cambridge, MA 02141 617 484-1606

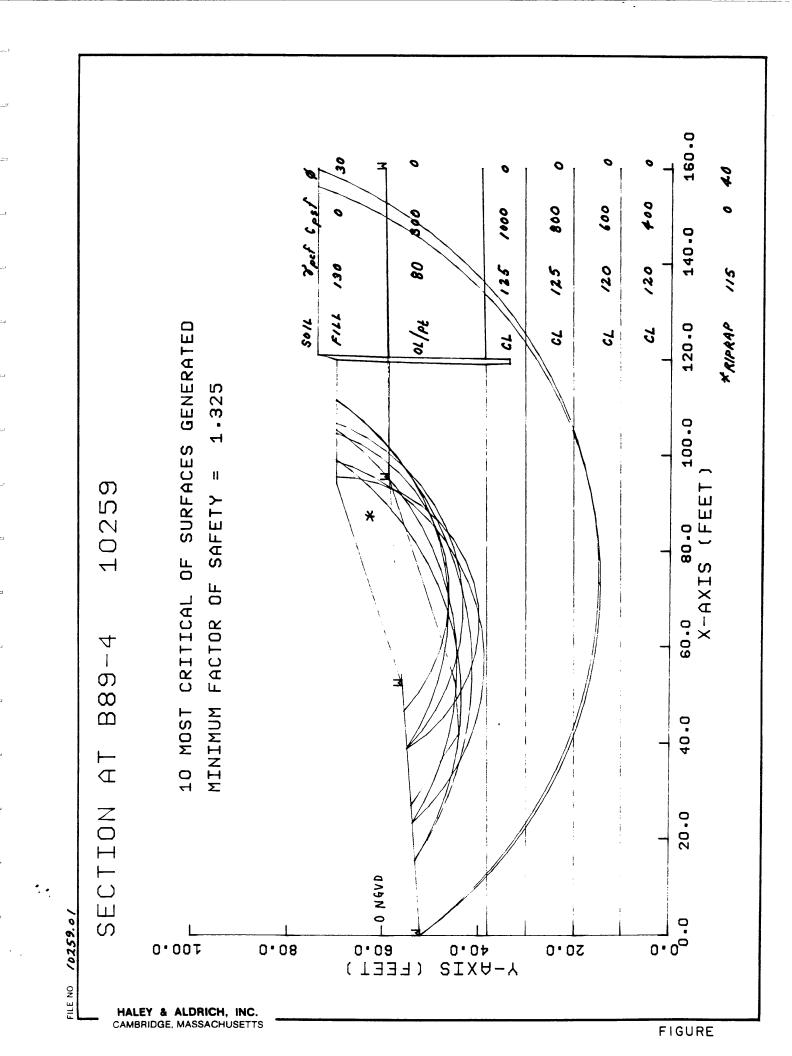
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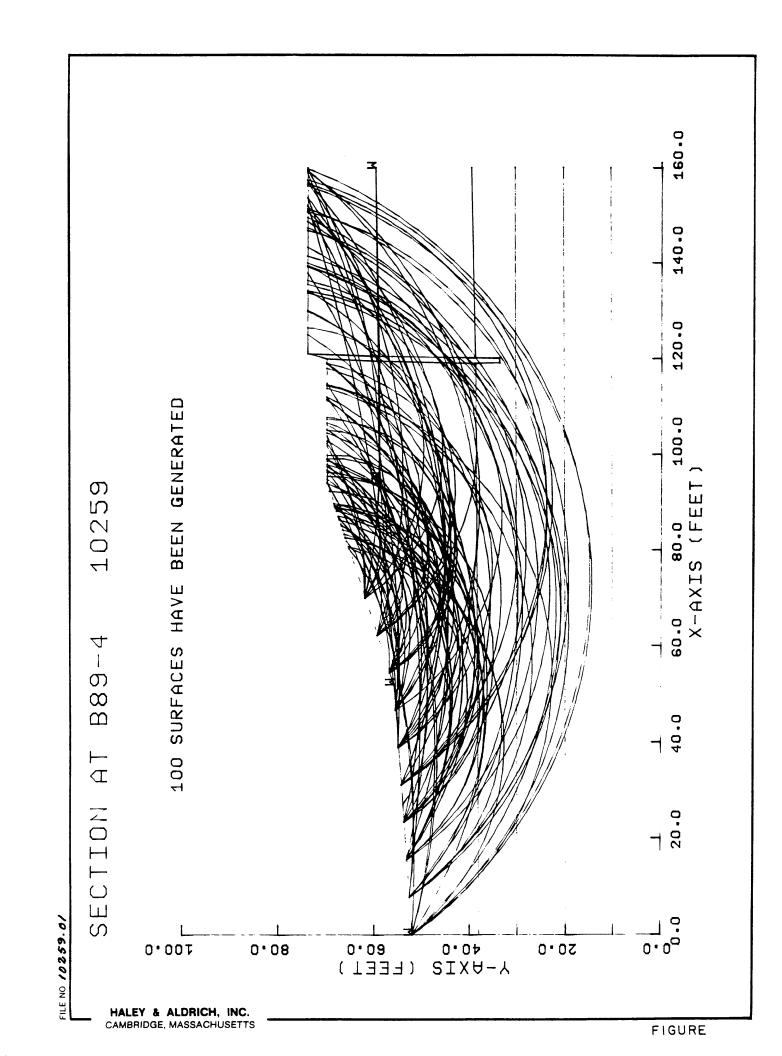
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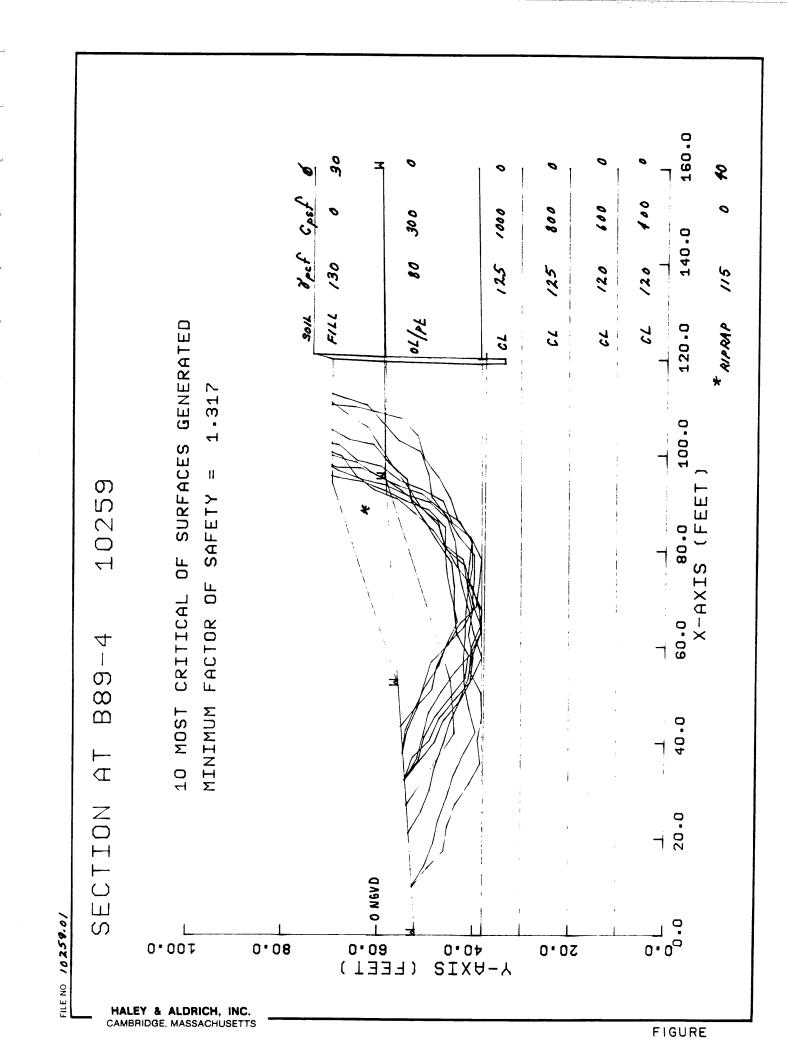
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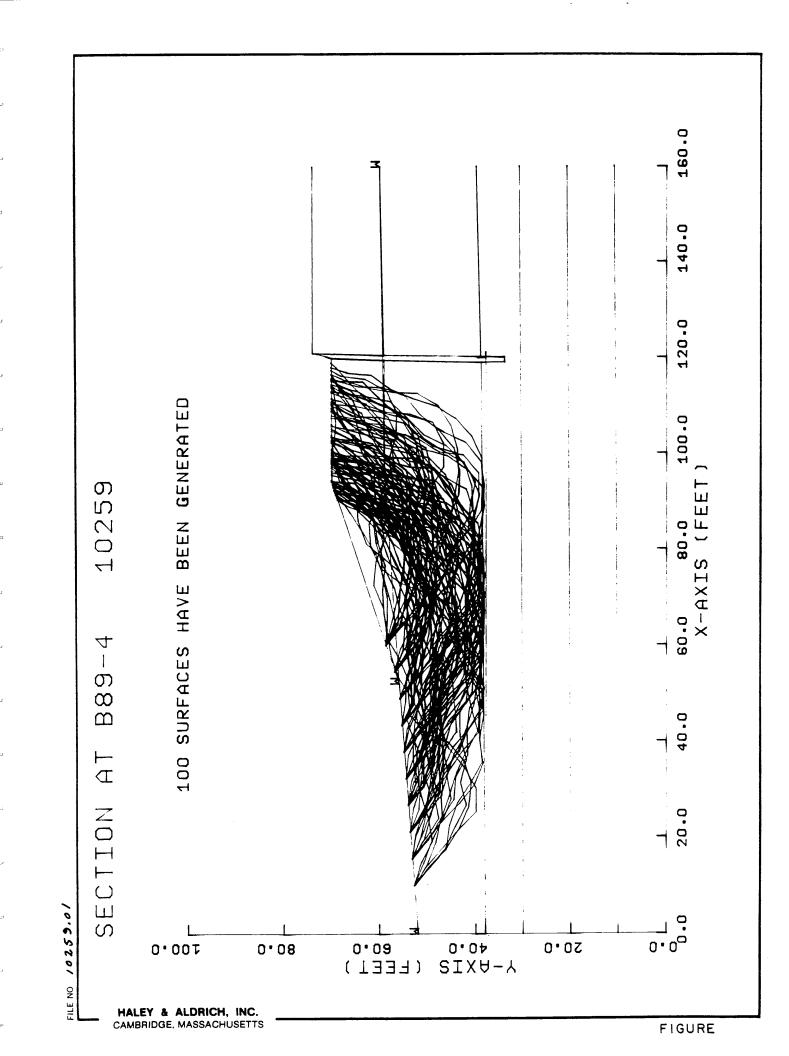
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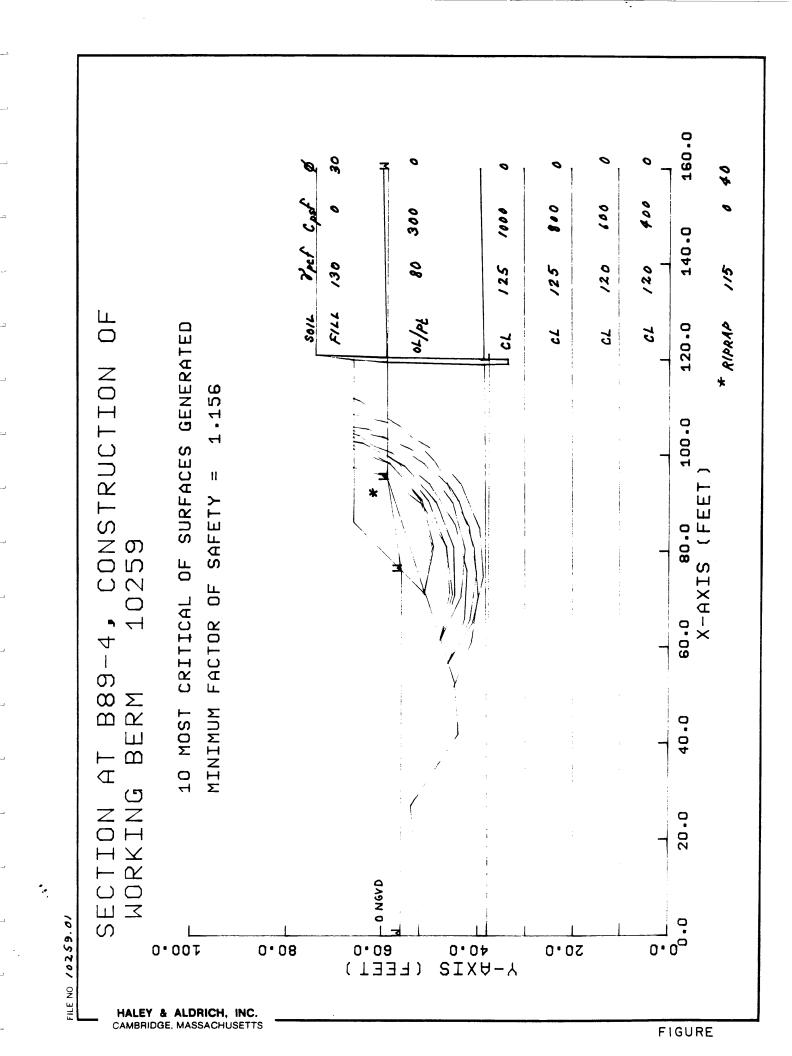
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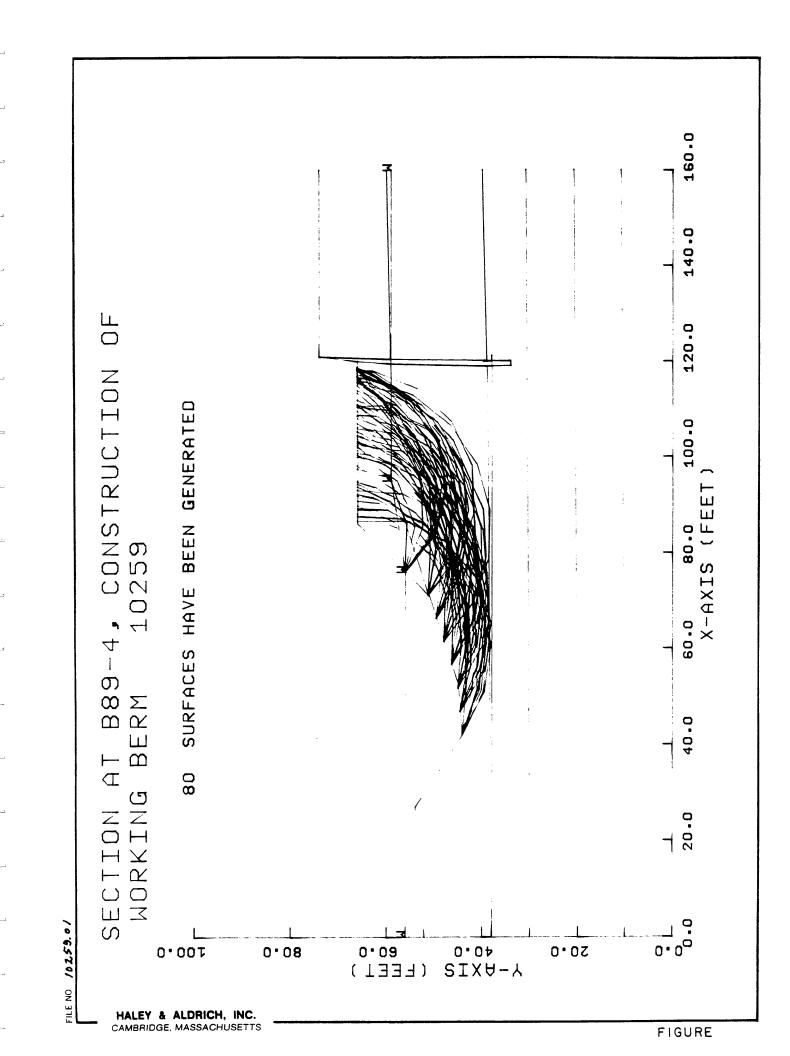


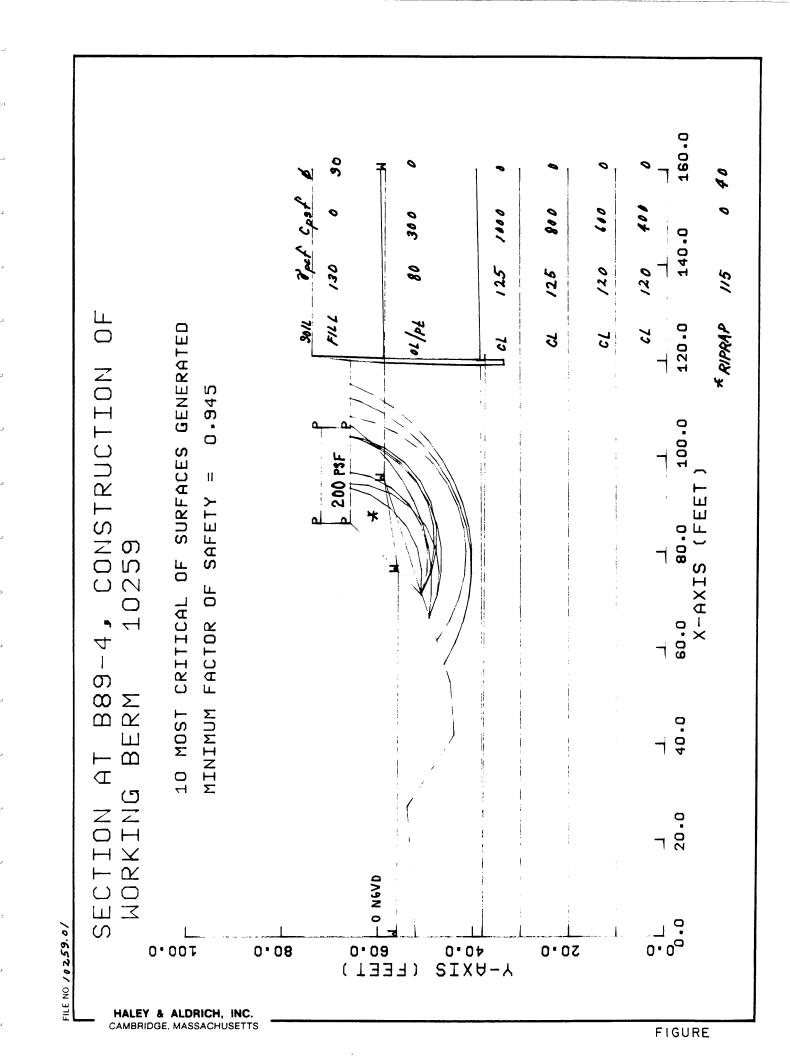


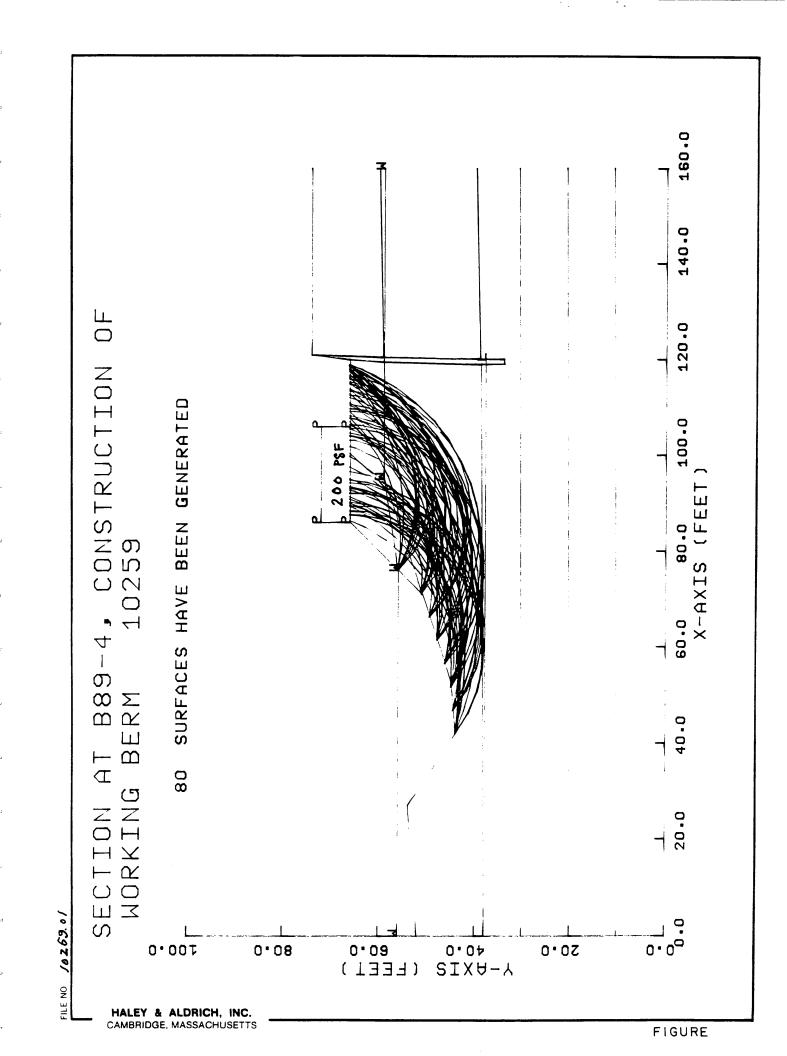


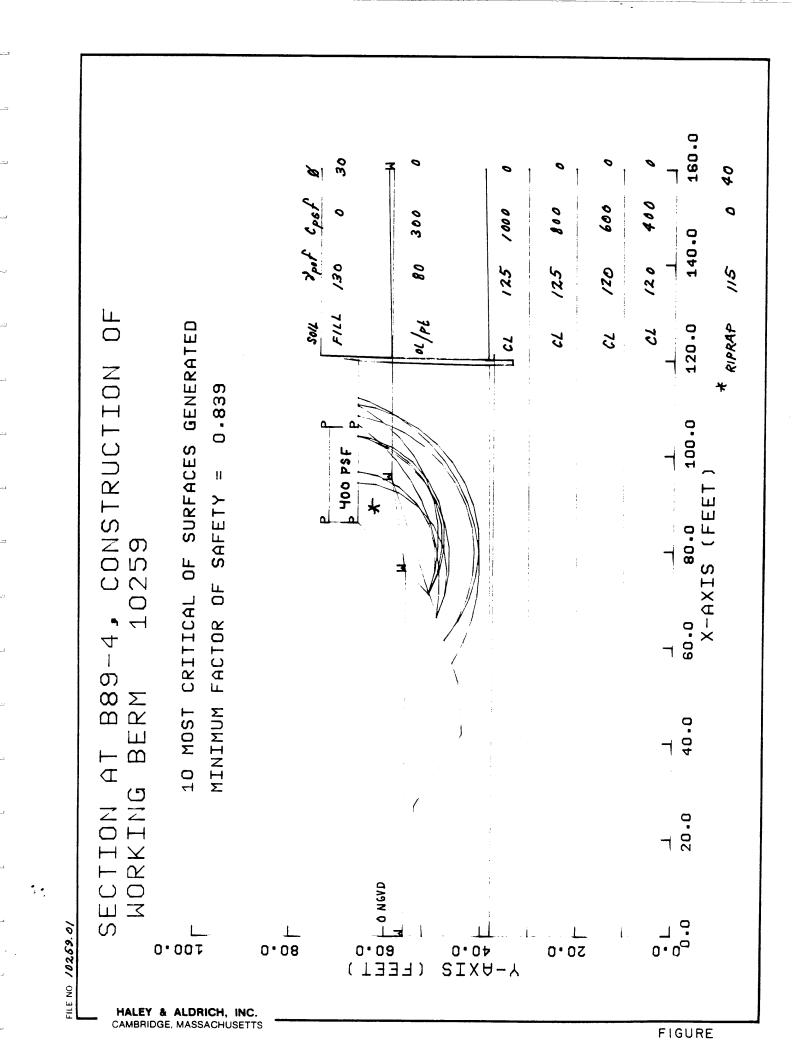


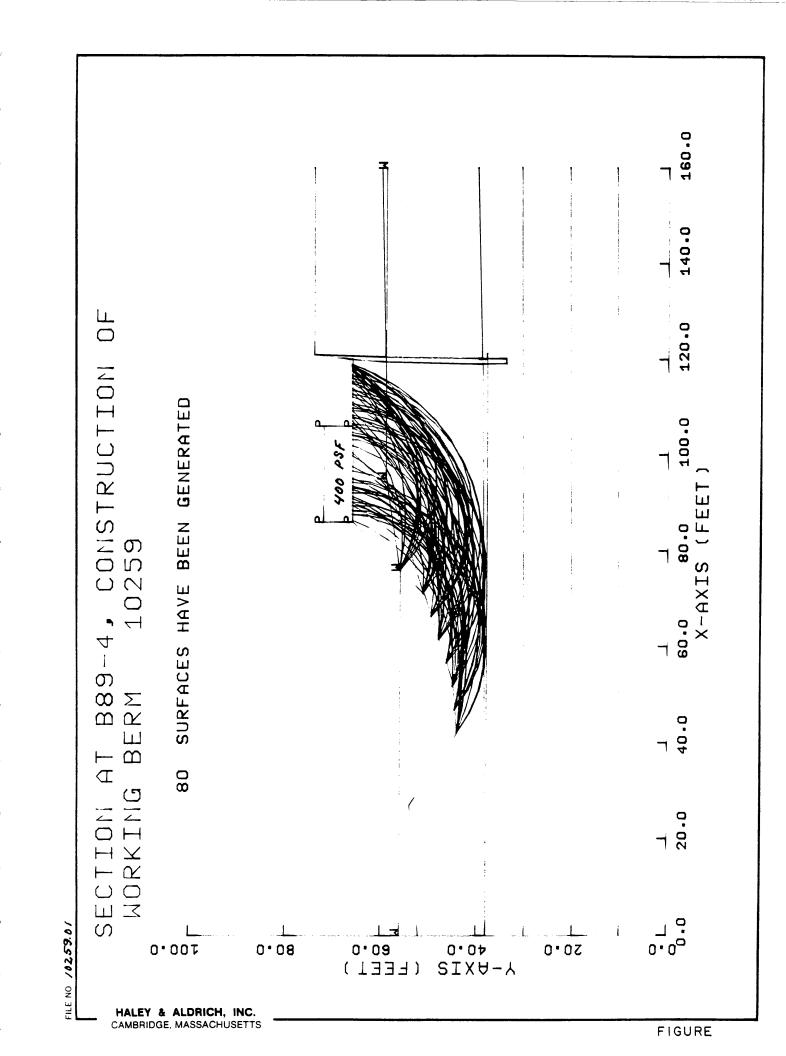


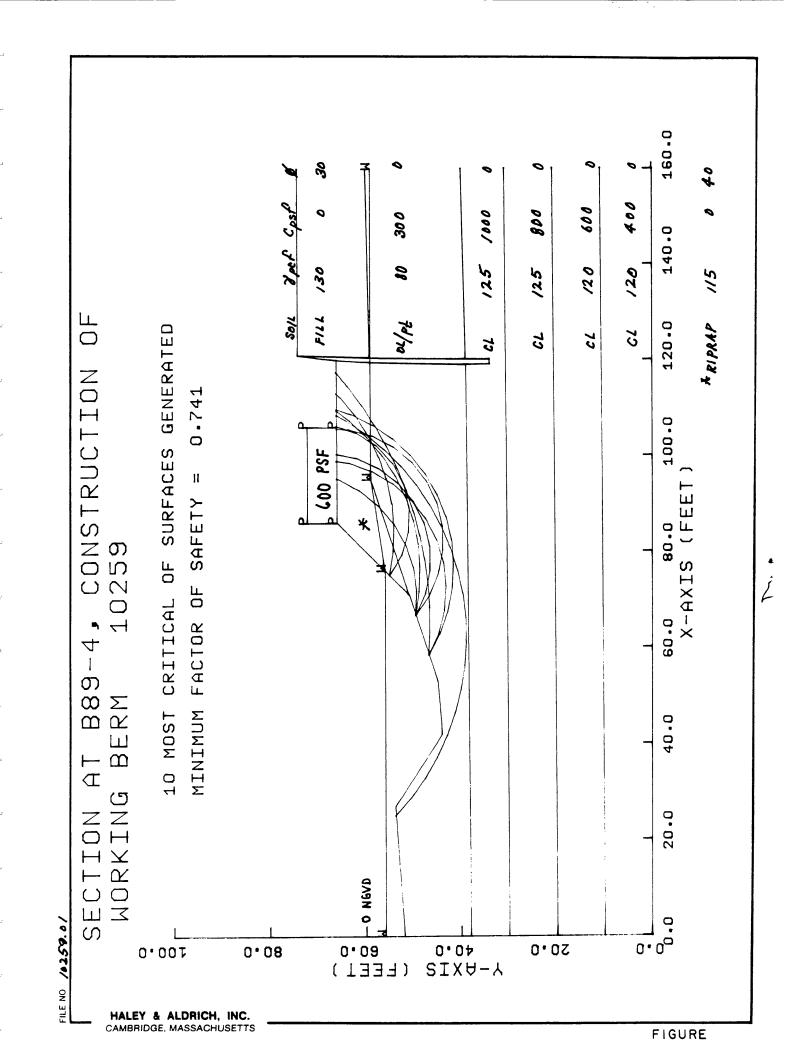


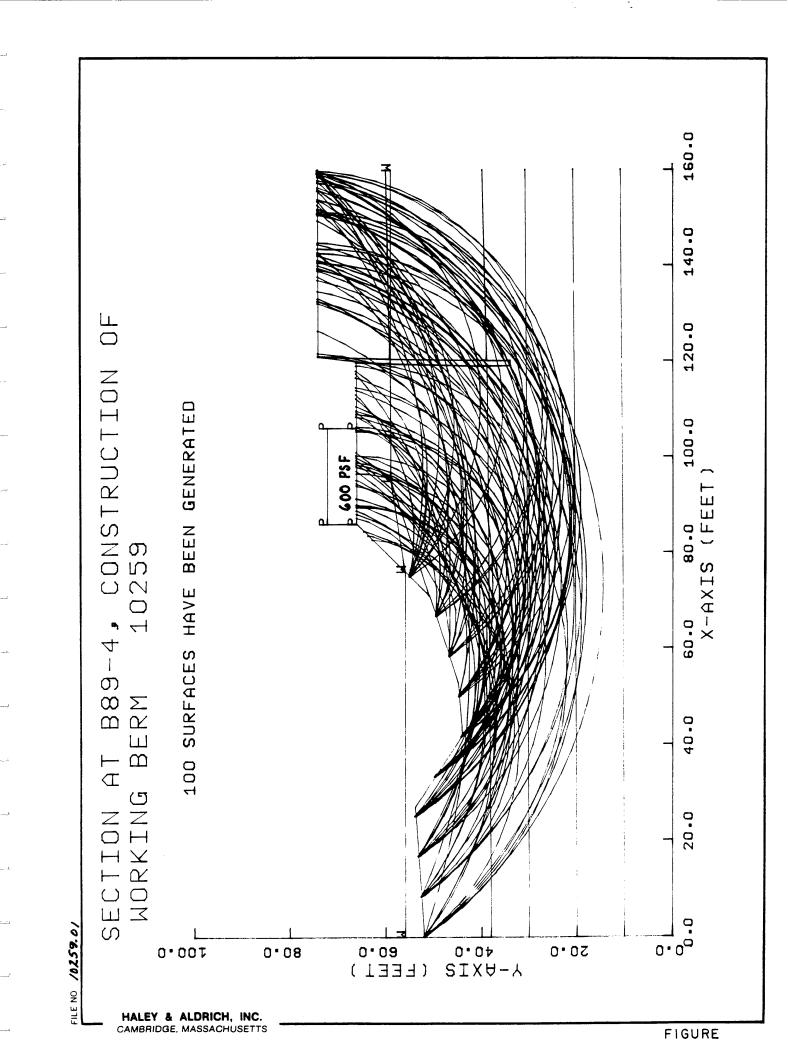


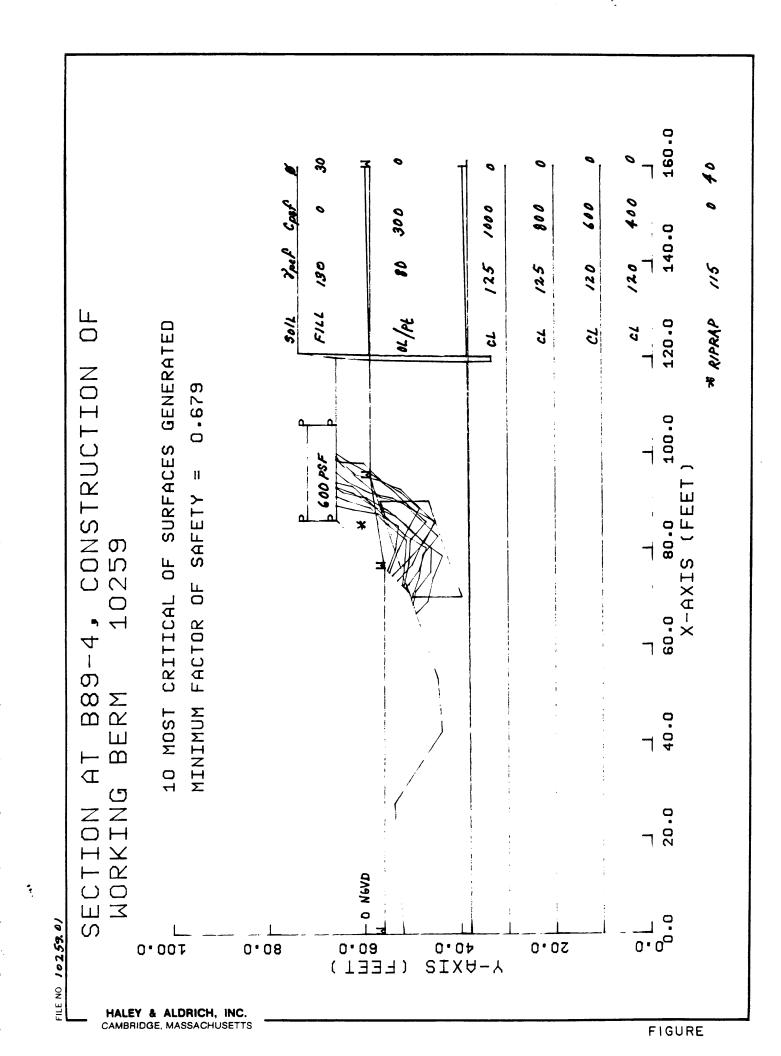


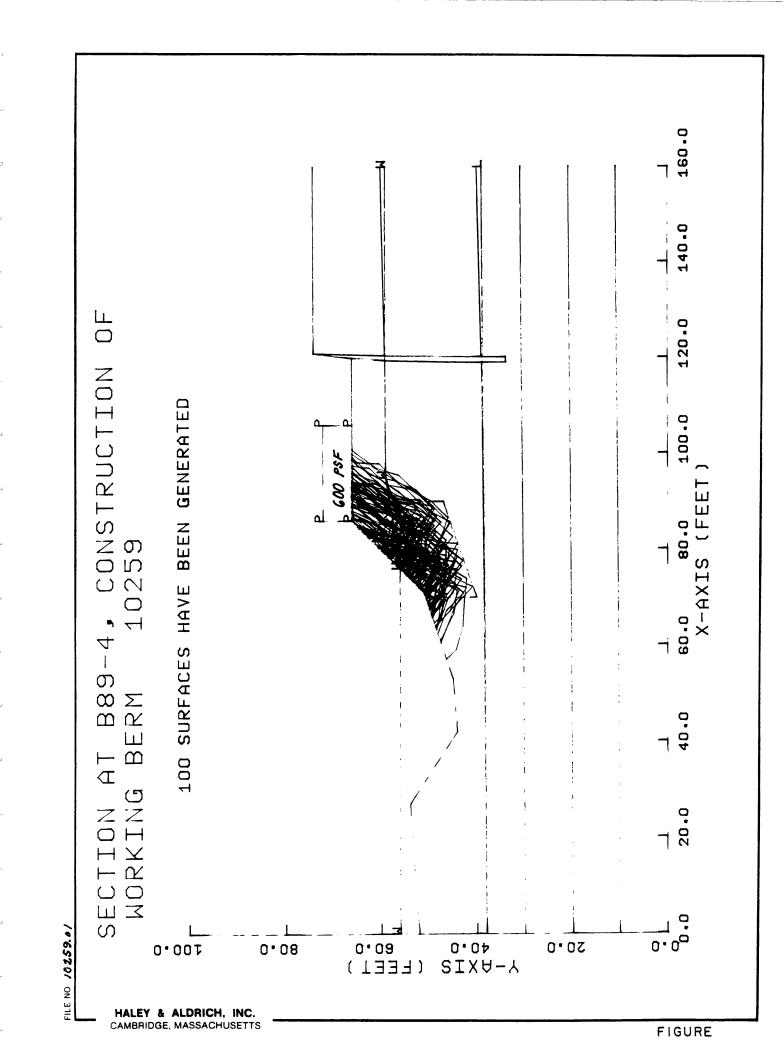


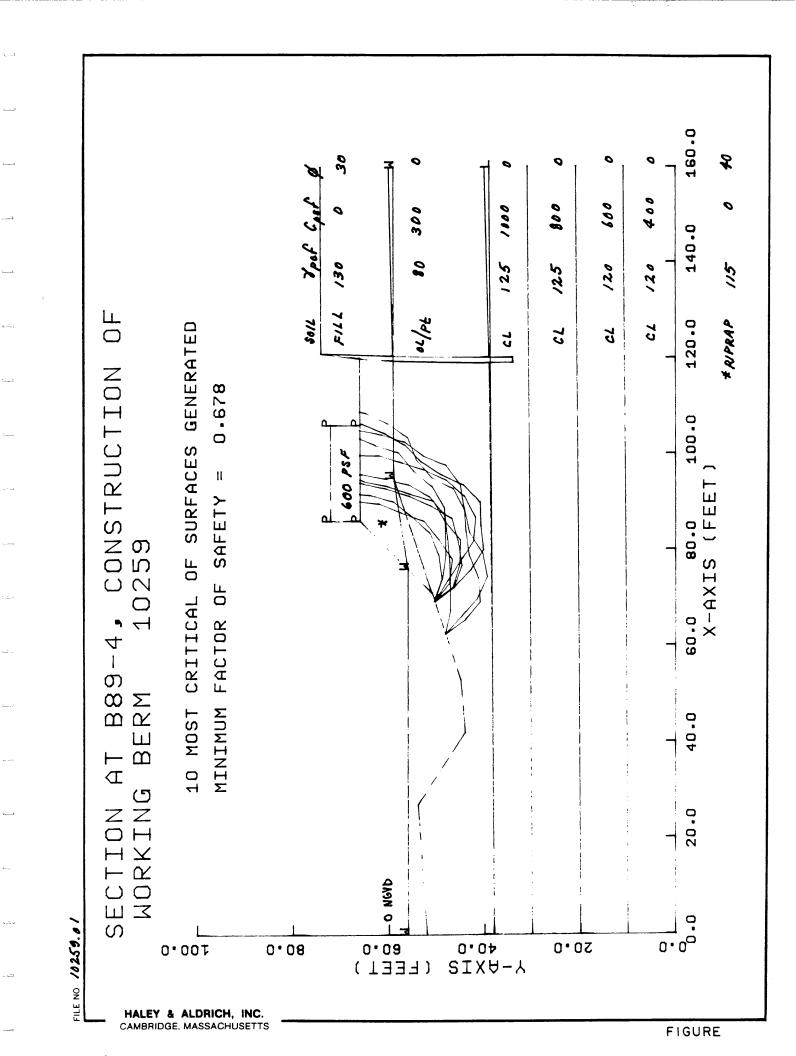


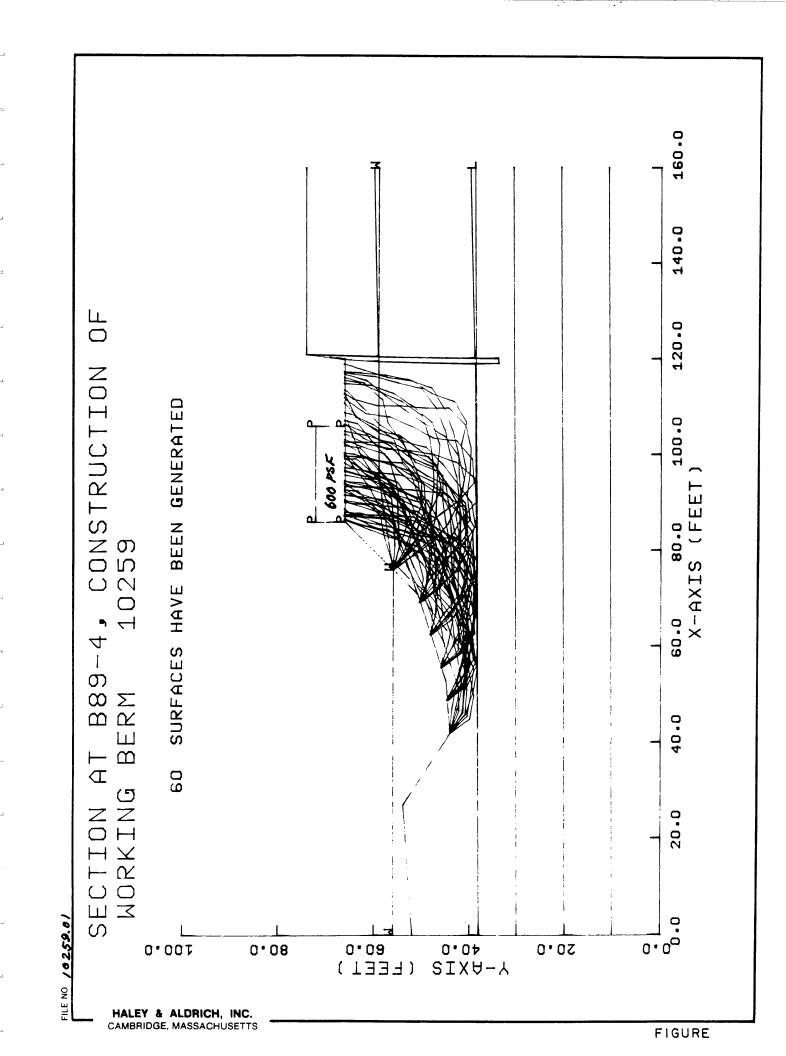


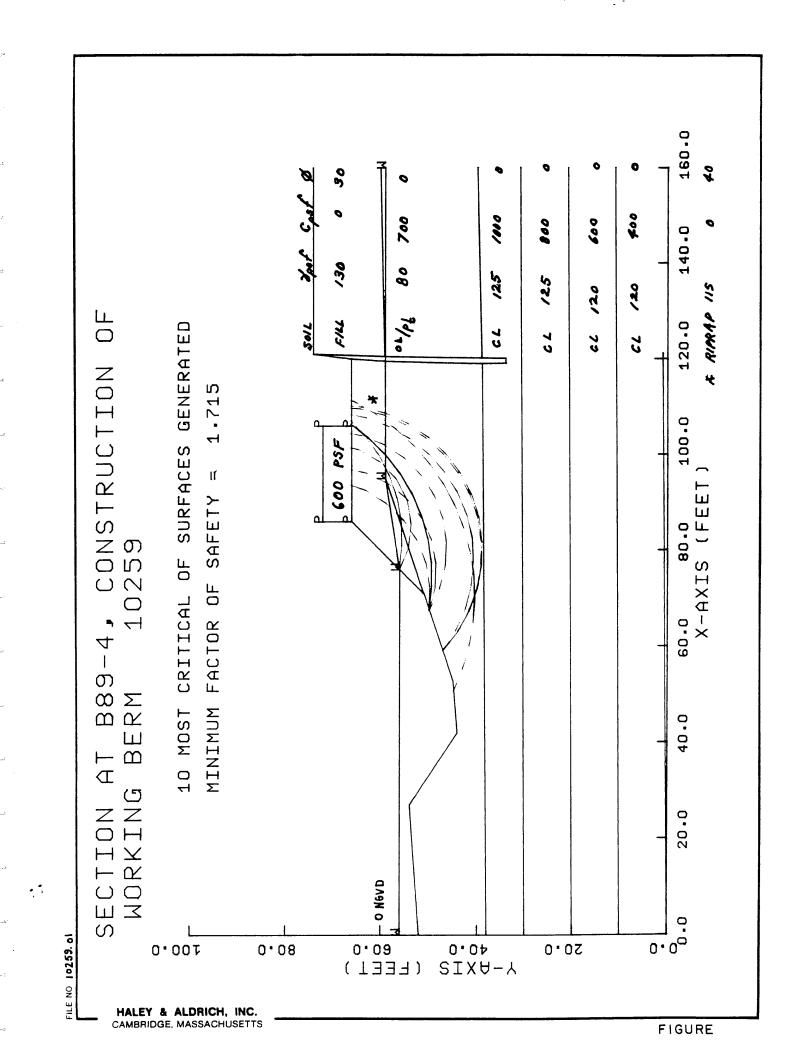


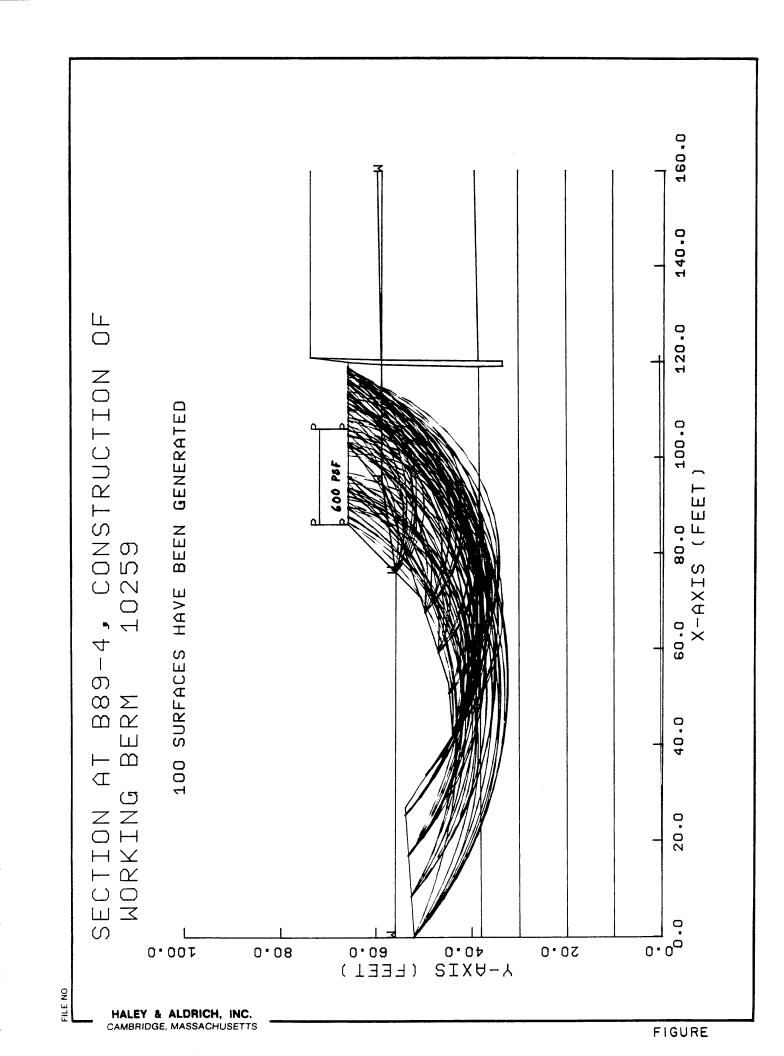




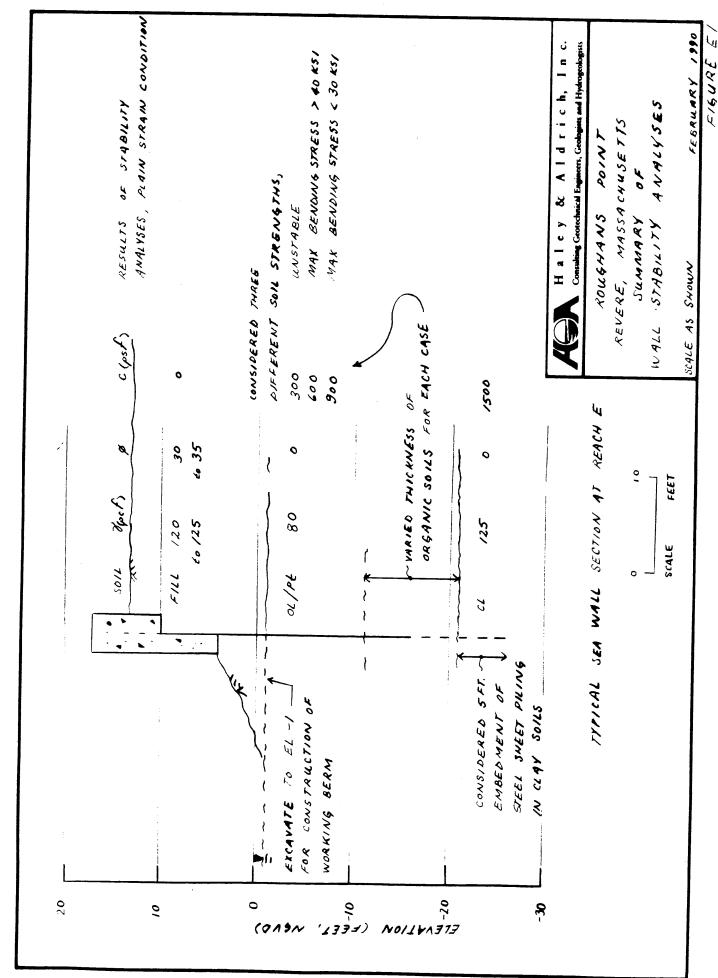


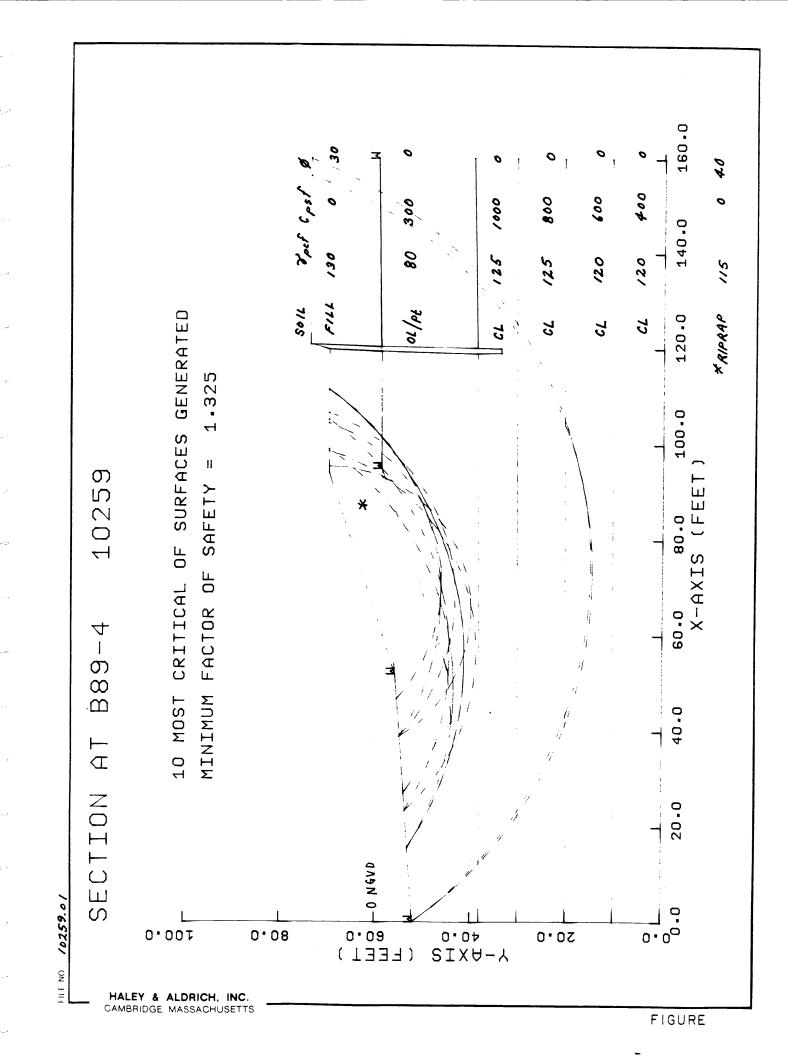


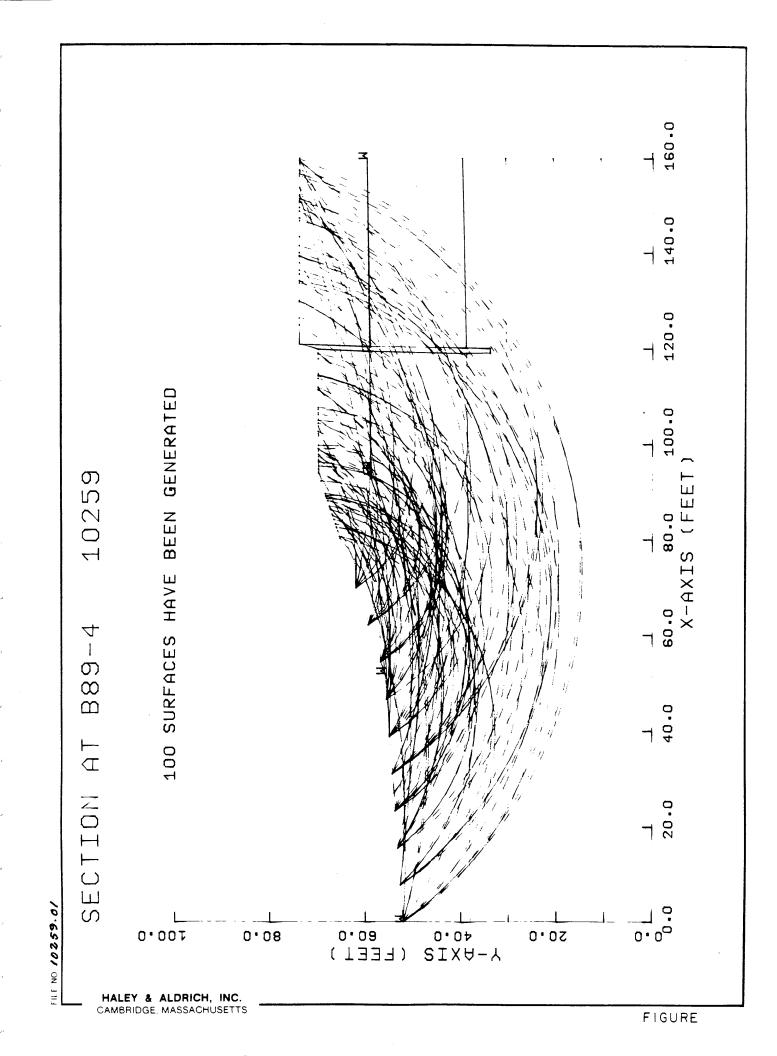


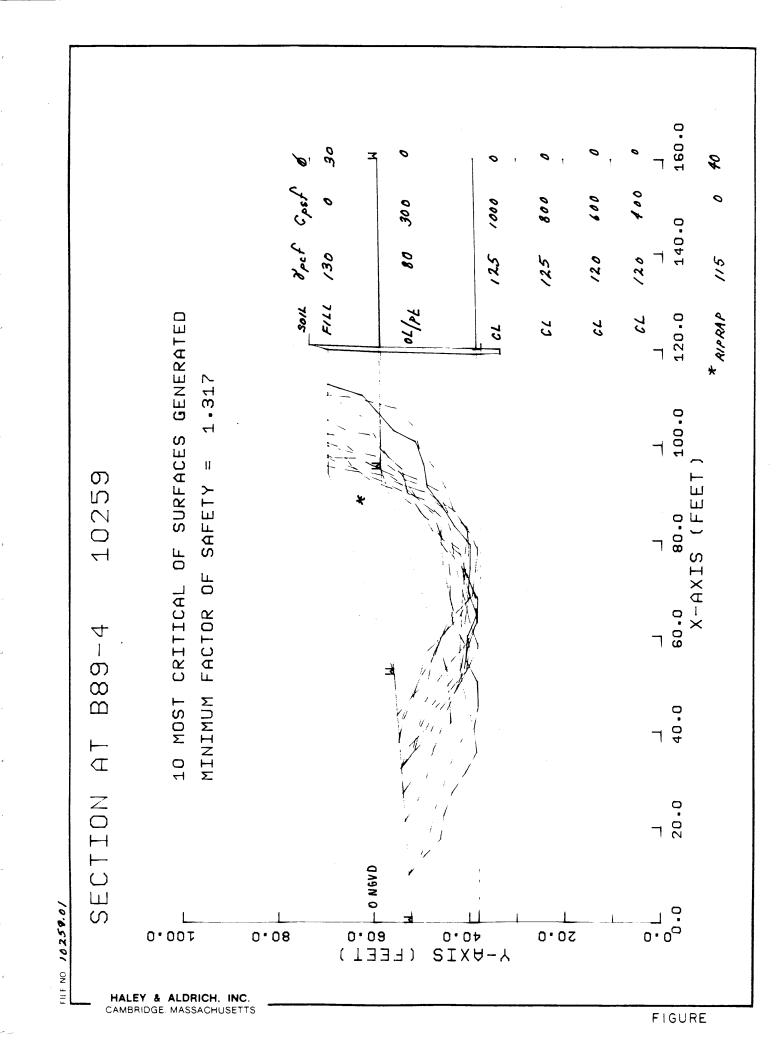


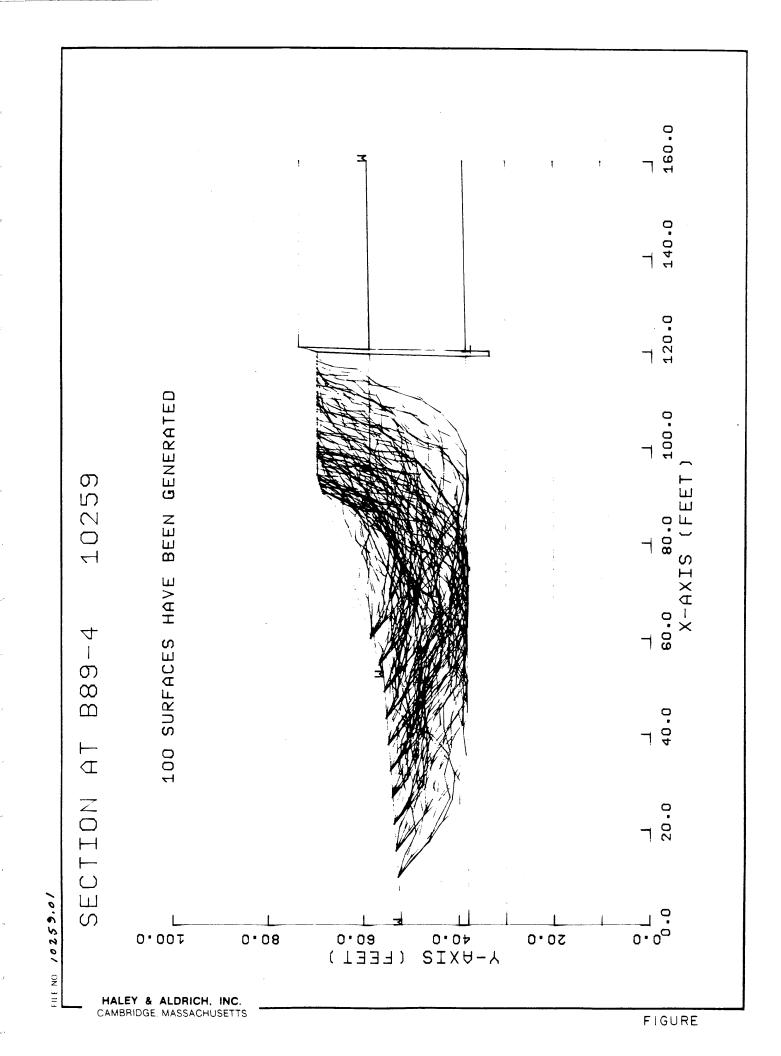
APPENDIX E
Plotted Results of Stability Analyses

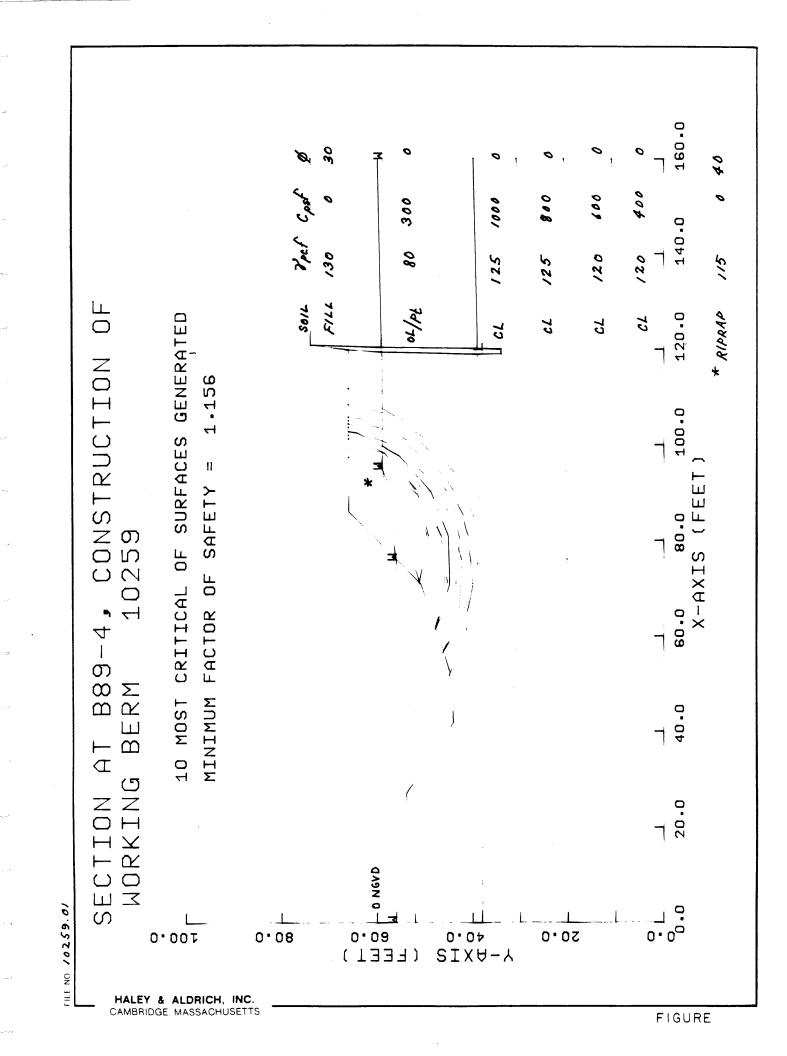


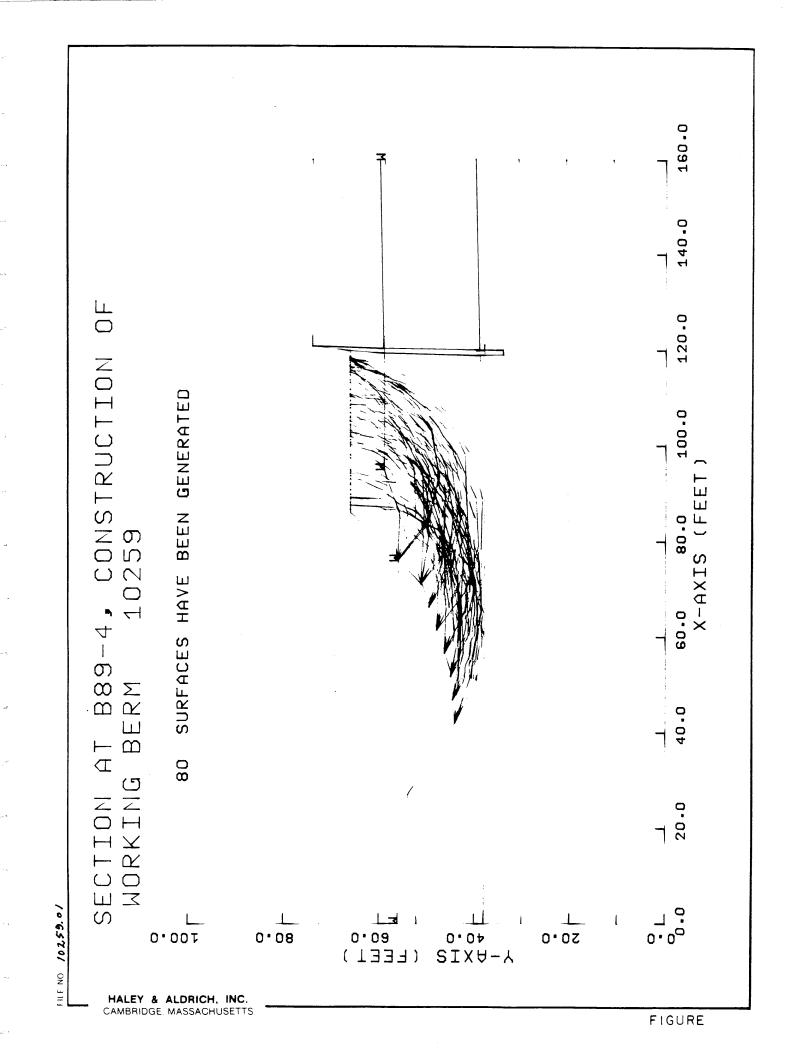


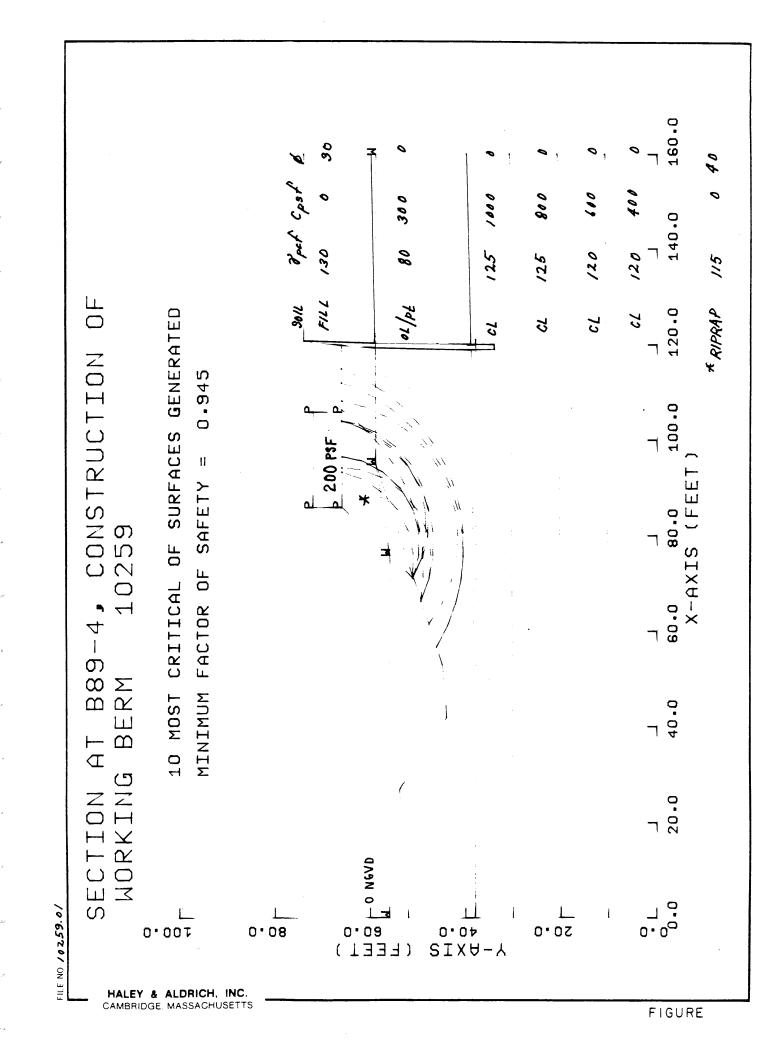


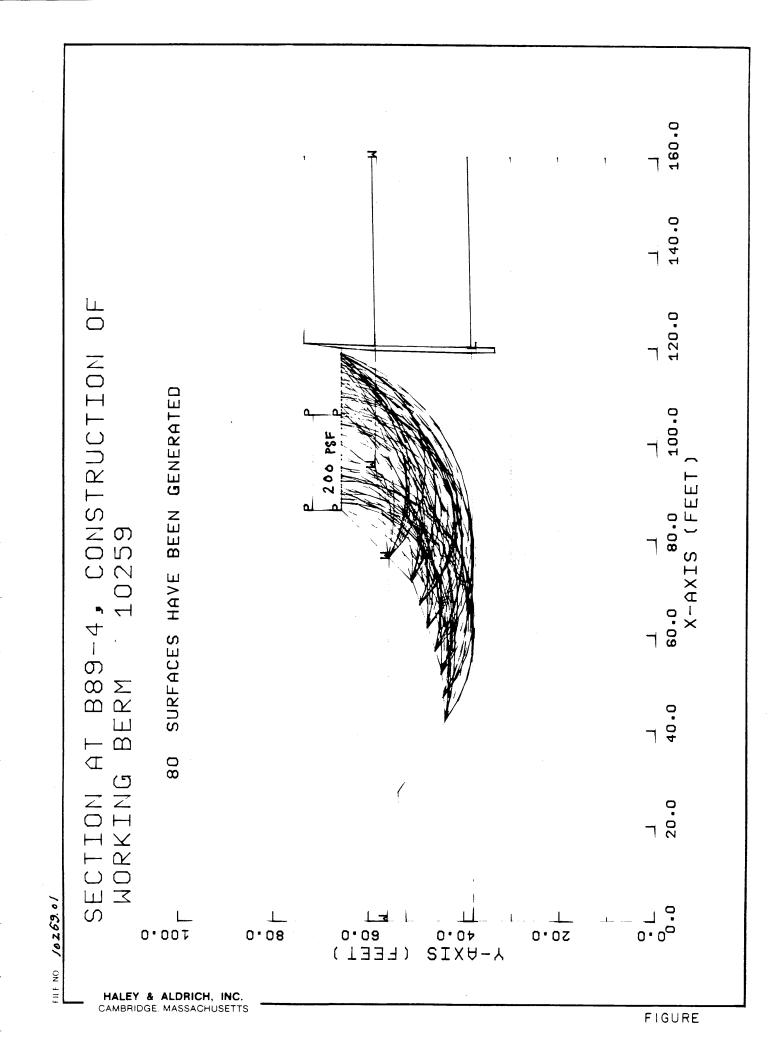


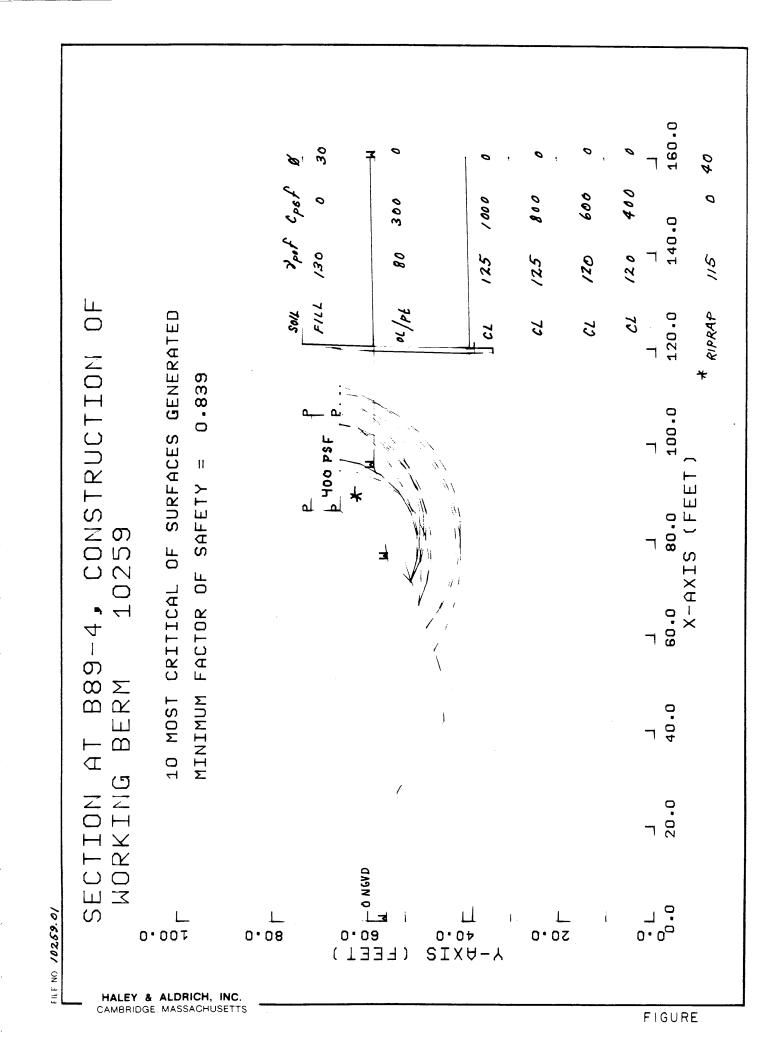


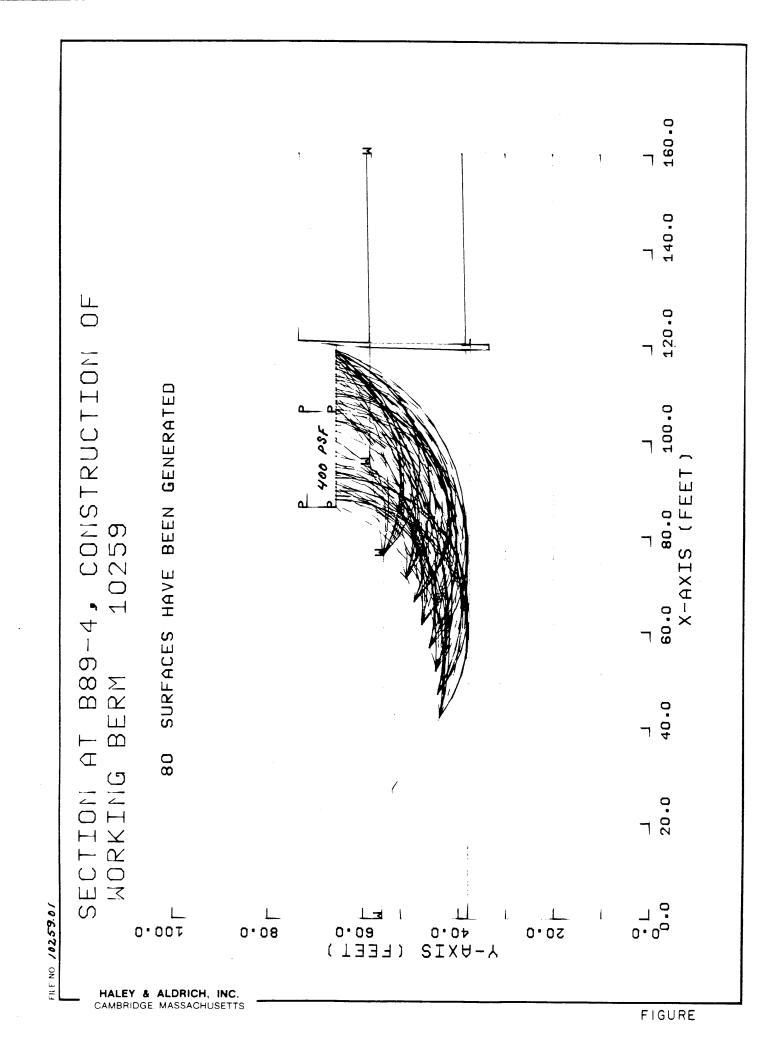


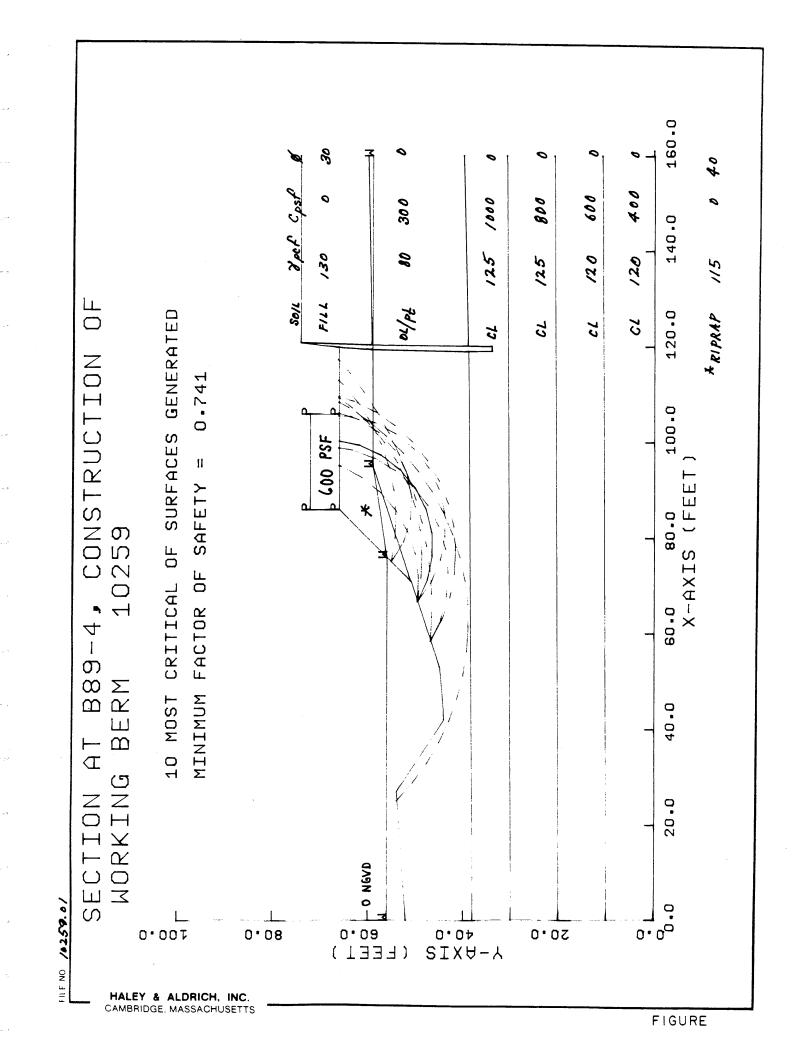


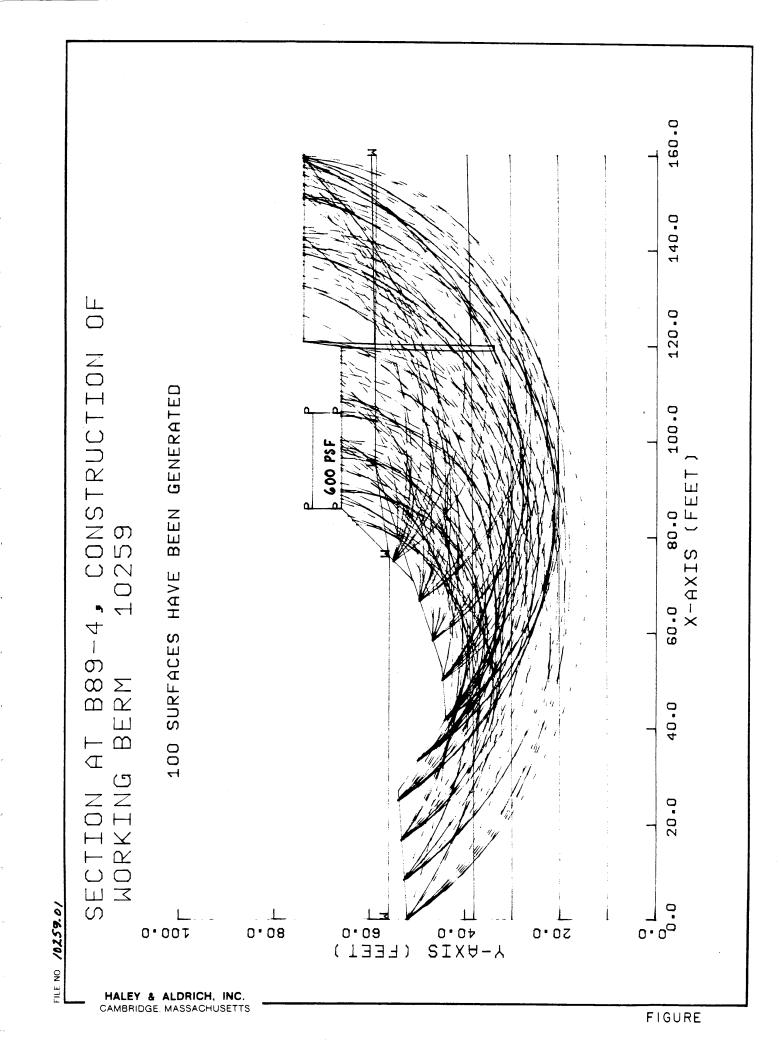


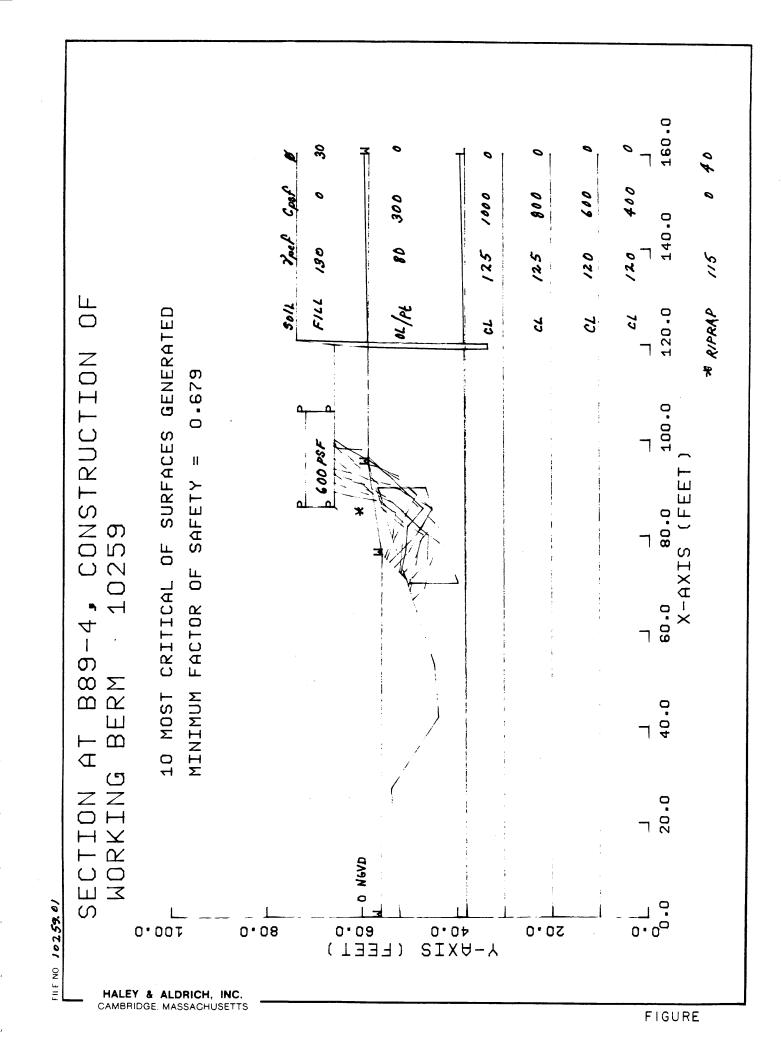


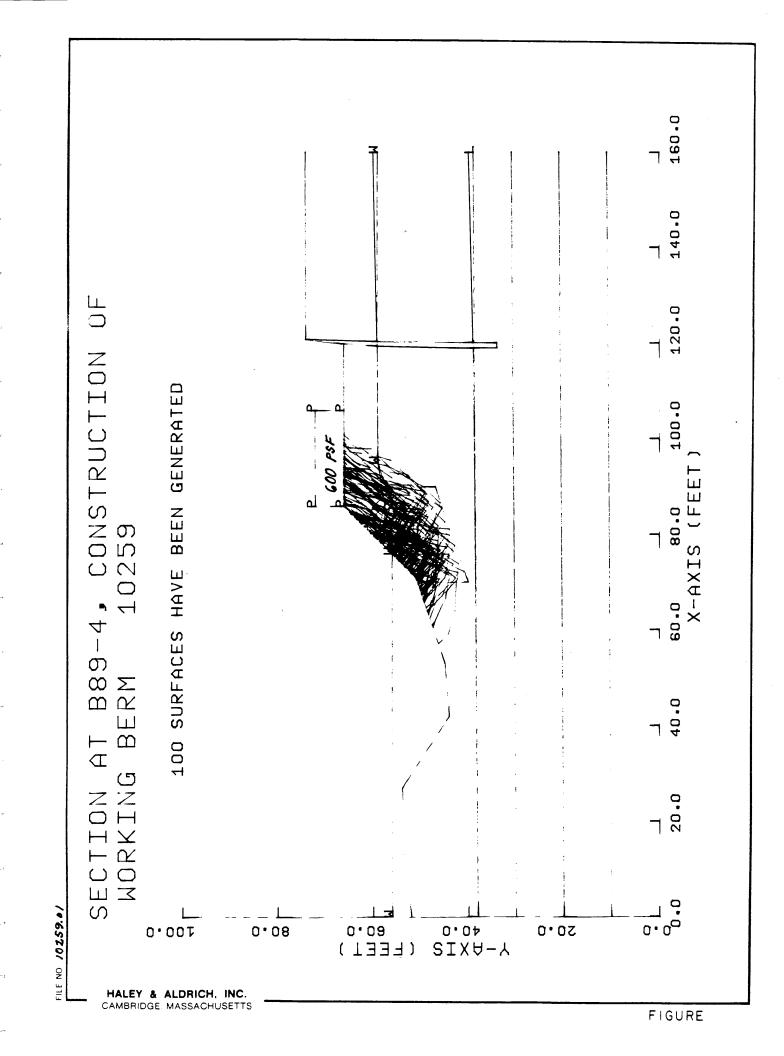


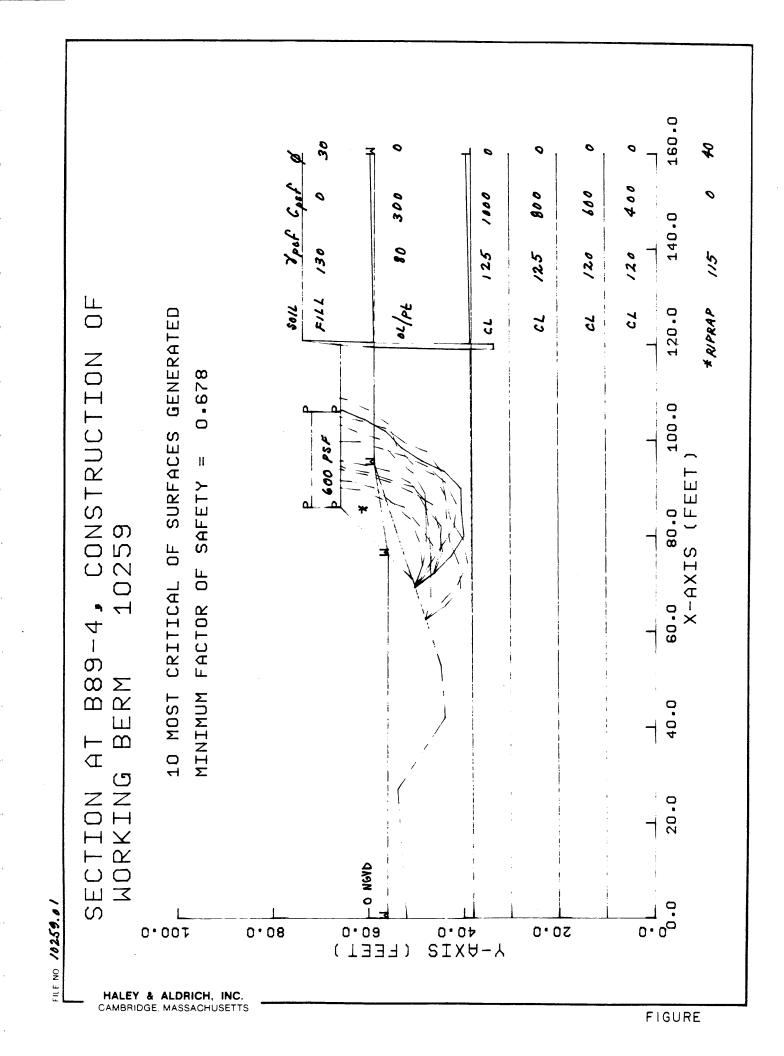


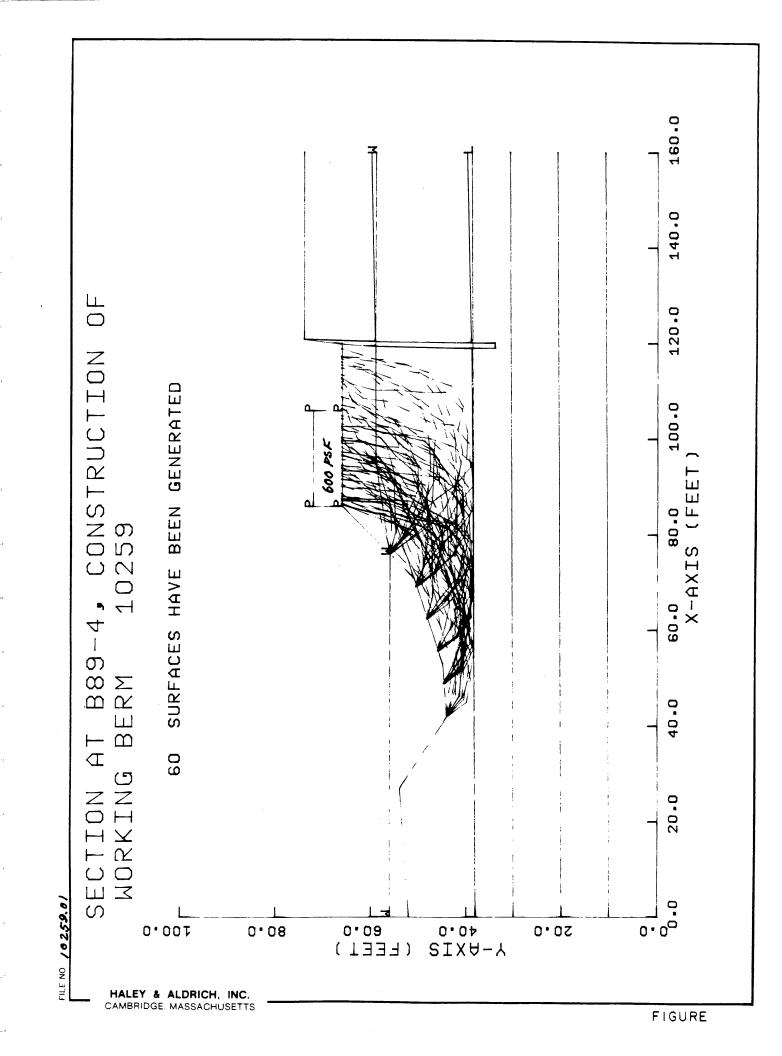


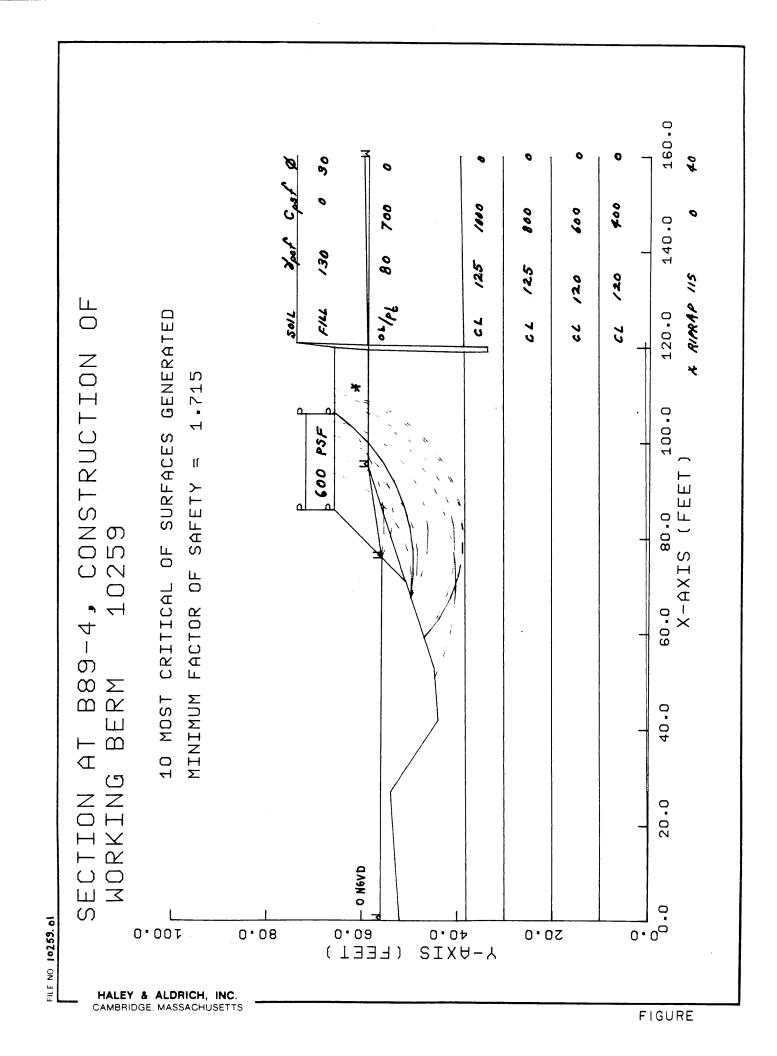


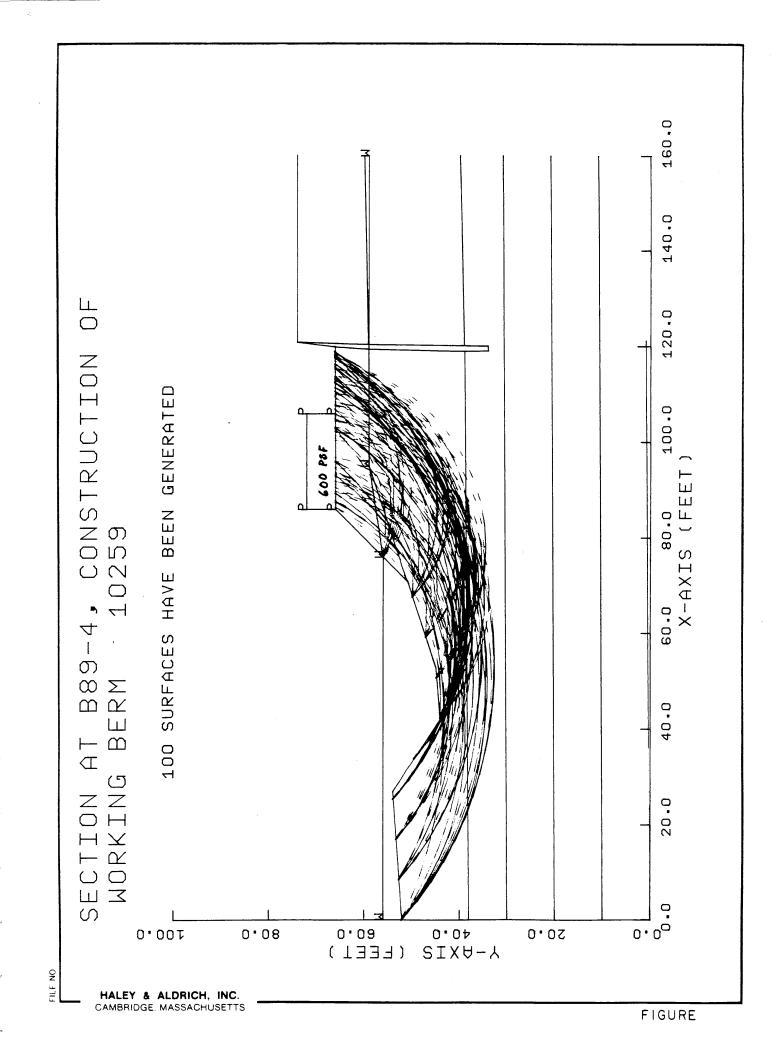












 $\label{eq:appendix} \mbox{ APPENDIX F}$ Plotted Results of Settlement Analyses

